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Introduction

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The Preliminary Edition of the *NASA Thesaurus (December 1967)* (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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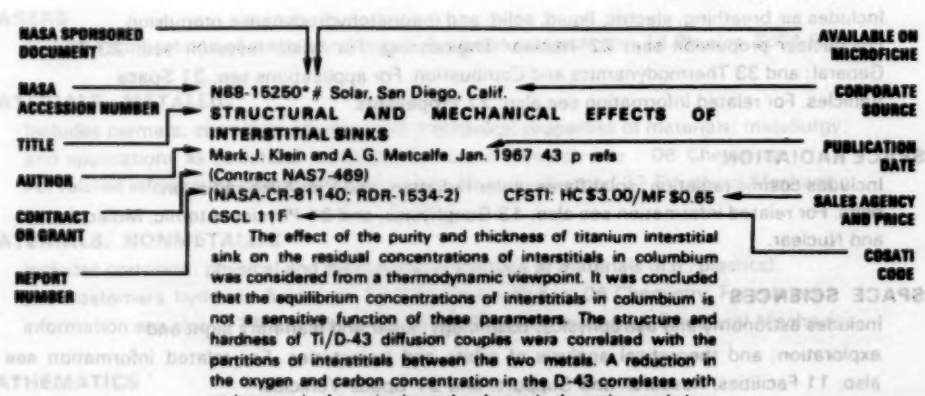
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STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-11036*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION OF A DEFLECTED-SLIPSTREAM CRUISE-FAN V/STOL AIRCRAFT WING

William A. Newsom, Jr. Washington Dec. 1967 54 p refs (NASA-TN-D-4262) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation was made of a wing with ducted fans mounted so that the slipstream would spread over most of the span of the wing. The wing was equipped with a double slotted flap and the ducts could be mounted at various positions on the leading edge. Tests were made for three different duct exit configurations over a range of angles of attack and fan thrust for various flap angles. The greatest amount of circulation lift was induced on the wing when the two ducts were mounted at the 1/4- and 3/4-semispan stations and when the slipstream from the ducts was divided with one-third of it going over the wing and two-thirds of it beneath the wing. The investigation also showed that chordwise fences on the upper surface of the flaps were effective in improving the turning effectiveness of the flaps and increasing the lift induced on the wing by the duct exit flow. The efficiency of the subject powered lift system was such that the model had a desirably low thrust required curve throughout the transition speed range. In this speed range the thrust required closely approximated that required as calculated from momentum relations based on the idealized assumption of an elliptical distribution of lift across the entire span of the wing. A slipstream deflection angle for hovering flight of 88° with a thrust loss of only 8% was obtained with the subject model. Author

N68-11230# Air Vehicle Corp., La Jolla, Calif.

MODIFIED WEISSINGER LIFTING SURFACE METHOD FOR CALCULATING AERODYNAMIC PARAMETERS OF ARBITRARY WING-CANARD CONFIGURATIONS

P. M. Yager, C. H. Holland, Jr., and T. Strand Aug. 1967 60 p refs
(Contract N00014-67-C-0143)
(Rept.-354; AD-660423)

A digital computer program for calculating lift, induced drag, pitching moment, and span loading of rigid wing-canard configurations in steady flight is presented. The method employed is essentially a modification of the Weissinger L-method. The effect of the canard on the wing is assumed to be due to two counter-rotating viscous-core vortices. The position of the vortices relative to the rear wing is taken into account by superimposing the separate downwash fields of the canard and the wing in an iteration method. The canard is shown to have an adverse effect upon the lift curve slope and induced drag, and to significantly decrease the static margin. In addition, a strong nonlinear pitch-up tendency is found to occur when the trailing vortex from the canard approaches the lower wing surface. Author (TAB)

N68-11253*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF THRUST AND ALTITUDE IN STEEP APPROACHES ON GROUND TRACK NOISE

John A. Zalovcik Washington Nov. 1967 13 p refs
(NASA-TN-D-4241) CFSTI: HC$3.00/MF$0.65 CSCL 01B

A brief analysis was made of measurements of sound pressure level taken during approaches of a four-engine medium-range turbojet transport to determine the variation of sound pressure level with thrust and altitude for various glide slope angles. The sound pressure level data were obtained at four ground stations during 3° approaches with several flap deflections which provided variations in airplane drag and hence in the required thrust. The thrust required for stabilized flight on the 3° glide slope was computed from lift-drag polars available for the airplane for the three flap deflections. By using the measured height of the aircraft above the four ground stations, the computed thrust, and the measured sound pressure level, the variation of sound pressure level with aircraft height and thrust for stabilized flight on 3° to 7° glide slopes was derived. The results of the analysis indicated that by increasing the glide slope from 3° to 6°, the value of the sound pressure level could be reduced 11.5 to 14.0 dB, depending on the ground station location. Of this reduction, about 7.5 dB would be due to reduction in thrust and the remainder (4 to 6.5 dB), to increase in altitude. Values of sound pressure level computed on the basis of this analysis at one ground station for several steep approach profiles flown showed good agreement with sound pressure level measurements made during the steep approaches. Author

N68-11375# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
COMPUTATIONS OF THE NONEQUILIBRIUM FLOW OF A VISCOUS RADIATING FLUID ABOUT A BLUNT AXISYMMETRIC BODY. VOLUME 1: EQUATIONS AND RESULTS
Final Report, 30 Jun. 1965–1 Mar. 1967
James T. Curtis and Charles R. Strom Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Jun. 1967 151 p refs
(Contract AF 33(615)-3132)
(CAL-AM-2113-Y-1, V. 1; AFFDL-TR-67-40, V. 1; AD-660104)

A Fortran IV computer program capable of calculating the radiant, viscous, nonequilibrium flow about a blunt-nosed axisymmetric or two-dimensional body is described. The program uses an iterated inverse method in the subsonic transonic region and a modification of the method of characteristics in the supersonic region. The displacement effect of the boundary layer is accounted for by a unique step-by-step method. Equilibrium radiation at the nonequilibrium temperature and composition is computed and used to calculate the radiant heating of the body nose assuming the shock layer is optically thin. An optional calculation of the effect of a magnetic field on the ionized flow in the nose region is included. The report concludes with the analysis of the nonequilibrium flow over a hemisphere cylinder at 14,000 fps. Author (TAB)

N68-11418# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REDUCING AERODYNAMIC RESISTANCE HOLES WITH ANNULAR RIBS AND RECESSES
K. I. Khanzhonkov 23 Dec. 1966 28 p Transl. into ENGLISH from Prom. Aerodinamika (Moscow), no. 12, 1959 p 181–196
(FTD-HT-66-371; TT-67-63248; AD-660433)

The article describes means of reducing the aerodynamic resistance of holes with annular ribs and recesses. One way is to make the edge of the opening turned toward the stream rounded. The principle of action of annular fins and recesses are explained and their optimum geometrical dimensions at which input resistance becomes minimum are revealed. Experimental installations and testing methods are described. Test results with both annular fin and annular recess are given and discussed. Author (TAB)

N68-11576 Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
ON THE HISTORICAL DEVELOPMENT OF FLIGHT DYNAMICS [ZUR ENTWICKLUNGSGESCHICHTE DER FLUGMECHANIK]
H. Herb Brunswick (West Germany) Deut. Forschungsanstalt für Luft- und Raumfahrt Jul. 1967 203 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-44) CFSTI: $3.00

The development of aircraft construction advanced due to the progress made in the field of flight dynamics and aerodynamics inclusive. Starting from the subdivisions "weight and lift", "performance" and "stability and control" the progress of development is analysed by means of old and modern aircraft data; the results are represented in diagrams. Prognostic estimations formerly made by experts for the future development are often cited. It has been evident that the actual development in all considered cases proceeded more favourably than predicted by prognostic estimations. Author

N68-11583 National Aerospace Lab., Tokyo (Japan).
AN APPROXIMATE ANALYTICAL SOLUTION FOR DISPERSION OF UNGUIDED ROCKETS DUE TO WIND WITH ITS APPLICATION TO THE CALCULATION OF WIND COMPENSATION FOR LAUNCHING
Hiroshi Moori 1967 33 p refs In JAPANESE; ENGLISH summary
(NAL-TR-131) CFSTI: $3.00

An approximate analytical method is developed for solving the five-degrees-of-freedom equations of motion (excluding the roll motion about the longitudinal axis) of a rocket with arbitrary wind. In the early period of the flight, the rocket is assumed to be accelerated uniformly. On this assumption, the equation of motion in pitch, including an aerodynamic damping coefficient, is reduced to a linear differential equation of the incident angle and can be solved exactly. Introducing this solution, equations of flight-path angles are easily integrated, and simple formulas are obtained. The formulas allow quick estimation of the flight path angles. Numerical examples show good agreement with the more exact results obtained by the electronic digital computer. The formulas are applied to determine launch angles for wind compensation, and a very simple but trustworthy method is obtained. Author

N68-11640* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AERODYNAMIC STABILITY CHARACTERISTICS OF THE APOLLO LAUNCH ESCAPE VEHICLE (LEV) WITH CANARD SUFACES DEPLOYED
William C. Moseley, Jr. and Bass Redd Washington Dec. 1967 108 p refs
(NASA-TN-D-4280) CFSTI: $3.00 CSCL 22B

A series of wind-tunnel studies was made to determine both static and dynamic stability characteristics of the Apollo launch escape vehicle, with canard surfaces in the deployed (open) position. This configuration is known as the post-abort vehicle. Results indicate that these canard surfaces are effective in producing a desired destabilizing increment in pitching moment. Positive damping was generally indicated. Author

N68-11653# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF OPTIMUM WIDTH OF UNVANED DIFFUSERS FOR SINGLE-STAGE CENTRIFUGAL SUPERCHARGERS [K OPREDELENIYU OPTIMAL'NOY SHIRINY BEZLOPATOCHNYKH DIFFOZOROV ODNOSTUPENCHATYKH TSENTROBEZHNYKH.NAGNETATELEY]
A. N. Sherstyuk, A. I. Sokolov, and V. P. Lysenko 3 May 1967 17 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 4, 1965 p 58–65
(FTD-HT-66-767; TT-67-63230; AD-660405)

The optimum ratio of diffuser width to rotor-blade width (in the exit section) for semiopen rotors is given. Conversion to the optimum B sub 3/B sub 2 ratio enables one to increase the supercharger efficiency by approximately 1.9% (absolute) as compared to the ratio B sub 3/B sub 2 = 1 that is generally adopted. The diffuser passage must be foreshortened from the front (on the side of the open gap between the ends of the rotor blades and the casing). A gain in efficiency is scored by reducing B sub 3/B sub 2 only provided that the transitional section is smooth, without any abrupt changes in the curvature of the boundaries. Author (TAB)

N68-11706# Technische Hogeschool, Delft (Netherlands).
LIFT AND DRAG CALCULATIONS ON DELTA WING-CONE CONFIGURATIONS HAVING SUBSONIC LEADING EDGES USING SLENDER-BODY THEORY [DRAAGKRACHTS- EN WEERSTANDSBEREKENINGEN MET BEHULP VAN DE "SLENDER-BODY" THEORIE AAN DELTA VLEUGEL-KEGEL CONFIGURATIES MET SUBSONE VOORRANDEN IN SUPERSONE STROMING]
W. J. Bannink and J. W. Reyn Jan. 1967 99 p refs In DUTCH; ENGLISH summary
(VTH-141) CFSTI: HC $3.00/MF $0.65

Configurations composed of a circular half cone mounted asymmetrically with respect to a flat delta wing with zero thickness and subsonic leading edges are studied using slender body theory

in order to determine whether the lift induced in the system by the cone in supersonic flow is produced efficiently enough to provide higher values of lift-drag ratios. These configurations are compared at equal lift coefficients and Mach number to symmetrical configurations composed of the same wing and a full cone with equal volume. Author

N68-11785 Aeronautical Research Council (Gt. Brit.).
AERODYNAMIC LOADS ON EXTERNAL STORES: A REVIEW OF EXPERIMENTAL DATA AND METHOD OF PREDICTION
P. Marsden and A. B. Haines London HMSO 1967 107 p refs Supersedes ARA-5; ARC-24509
(ARC-R&M-3503; ARA-5; ARC-24509) CFSTI: $3.00

A survey has been made of the available literature on the aerodynamic loads associated with the external carriage of pylon-mounted stores adjacent to wing-fuselage combinations. The existing methods for estimating the store/pylon loads at both subsonic and supersonic speeds are reviewed with some indication of their accuracy, range of validity and the extent to which they have been verified experimentally. Illustrations are given showing how the loads vary with store position, wing geometry, Mach number and other factors. Particular stress is laid on the fact that the pylon-induced effects can make a very large contribution to the store loads. Details are also given of the complex flow fields adjacent to typical wing-fuselage combinations since these are vital to any real understanding of the problem. None of the existing methods appears to be entirely satisfactory particularly for the transonic range where even the available experimental data are severely limited. In an attempt to meet one of the more important deficiences, a new empirical method is presented for the estimation of store/pylon side force. This method is based on all the readily available evidence but needs further experimental verification. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-11147*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
WIND-TUNNEL INVESTIGATION OF THE FLOW FIELD BENEATH THE FUSELAGE OF THE X-15 AIRPLANE AT MACH NUMBERS FROM 4 TO 8
Earl J. Montoya and Murray Palitz Washington Nov. 1967 92 p refs
(NASA-TM-X-1489) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Wind-tunnel data were obtained on the local flow field beneath the fuselage of a model of the X-15 airplane approximately 5 to 8 fuselage diameters aft of the model nose from the model surface to the bow shock. Multiple-tube rakes, model surface pressure orifices, and a cone probe were used to survey the flow field. Test results were obtained at free-stream Mach numbers from 4 to 8 and angles of attack from −3° to 20° and were compared with theory and flight data. Results indicate that Mach number, impact pressure, and flow-angularity gradients exist between the vehicle's surface and the bow shock. These gradients generally become larger with both increased angle of attack and Mach number. Good agreement with theoretical results at zero angle of attack was obtained. Mass flow through a proposed hypersonic ramjet engine inlet positioned beneath the X-15 was determined by using both a two-dimensional oblique-shock-wave assumption and wind-tunnel results. The two-dimensional oblique-shock assumption predicted a larger inlet mass flow than was obtained from the wind-tunnel data. Author

N68-11174*# LTV Aerospace Corp., Dallas, Tex.
ADDITIONAL STUDIES ON THE FEASIBILITY OF V/STOL CONCEPTS FOR SHORT-HAUL TRANSPORT AIRCRAFT
K. R. Marsh Washington NASA Dec. 1967 46 p refs
(Contract NAS2-3036)
(NASA-CR-670(01)) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Various V/STOL short haul transport aircraft design proposals were reevaluated in terms of size, range, noise levels, and other operating characteristics. Among the conclusions reported are: (1) Operation at nonoptimum cruise conditions would require revisions in the proposed aircraft designs. (2) Matching of propeller takeoff RPM and engine takeoff RPM would be economically advantageous and would provide reductions in far field noise characteristics. Matching resulted in increased cruise speeds for turboprop STOL aircraft; but for turboprop VTOL aircraft, reduced propeller takeoff tip speed and the increased engine takeoff RPM lowered hover performance, necessitating increases in engine size. (3) Existing noise prediction methods do not yield accurate propeller-driven aircraft noise predictions. E.C.

N68-11392# Interior Dept., Washington, D. C. Div. of Wildlife Research.
ESTABLISHING CERTAIN PARAMETERS OF HAZARDS TO AIRCRAFT BY MIGRATING BIRDS IN THE MISSISSIPPI FLYWAY Interim Report
Frank C. Bellrose (Ill. Univ., Urbana) Nov. 1967 84 p refs
(Contract FA-65-WAI-77)
(SRDS-RD-67-67)

The flight routes and times of passage of waterfowl are presented, emphasizing the Mississippi Flyway. However, several important routes leading to the Atlantic Flyway cross the Mississippi Flyway, requiring that some treatment of the Atlantic Flyway be included. The routes used by migrating waterfowl are mapped—for dabbling ducks, diving ducks, Canada geese, and blue and snow geese. The volume of waterfowl traffic is delineated where possible. Most waterfowl migrate at night and at relatively low altitudes, thereby reducing the potential hazard to aircraft. Knowledge of the altitudes utilized by migrating waterfowl offers a means of reducing the bird strike potential through changes in altitude assignments. Other means are to decrease aircraft speed under certain conditions where waterfowl traffic is deemed dangerous, and to reduce the time used when approaching or departing airports. Waterfowl passage is greatest following cold fronts in fall, especially between mid-October and December, and following warm fronts in the spring, especially between March 1 and April 10. Author

N68-11519*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF GROUND PROXIMITY ON THE LONGITUDINAL, LATERAL, AND CONTROL AERODYNAMIC CHARACTERISTICS OF A TILT-WING FOUR-PROPELLER V/STOL MODEL
Kenneth W. Goodson Washington Dec. 1967 112 p refs
(NASA-TN-D-4237) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A wind tunnel investigation of a four propeller tilt wing V/STOL configuration was conducted to determine the longitudinal, lateral, and control aerodynamic characteristics in ground proximity. The tests were made utilizing the moving-belt ground plane. The investigation showed that reductions in lift and drag occurred on the tilt-wing configuration when in ground proximity. Smoke-flow

observations showed that ground proximity caused the slipstream to be deflected forward of the model. At certain ground heights and wing-tile–flap-deflection angles, these self-generated disturbances became quite erratic. For some wing-flap angle combinations, the unsteady flow caused erratic yawing moments at 0° sideslip. Smoke flow observations also showed that the ground-height-to-chord ratio at which the onset of flow recirculation occurred was proportional to the ratio of disk loading to free-stream dynamic pressure. The extent of the recirculation in front of the wing was dependent upon the wing tile angle at a given flap deflection and ground height. Ground proximity reduced the aileron yaw control by about 50 percent for the design condition ($\delta_{a_L}=50°$; δ_{a_L} is the left-wing aileron deflection) at the lowest ground height of the tests. Increasing the aileron deflection to $\delta_{a_L}=-70°$ and deflection a 0.10-chord upper-surface spoiler increased the control yawing moment to about 70 percent of original out-of-ground-effect value obtained with $\delta_{a_L}=-50°$. Ground proximity also considerably reduced the adverse rolling moment due to aileron deflection for yaw control. Author

N68-11545*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

AN ANALYSIS OF THE LIMIT-CYCLE AND STRUCTURAL-RESONANCE CHARACTERISTICS OF THE X-15 STABILITY AUGMENTATION SYSTEM

Lawrence W. Taylor, Jr. and John W. Smith Washington Dec. 1967 52 p refs

(NASA-TN-D-4287) CFSTI: HC $3.00/MF $0.65 CSCL 01D

During the early flights of the X-15 airplane, two problems associated with the stability augmentation system were encountered: limit cycles, primarily in roll, and control-surface resonance. The limit cycles were usually only an annoyance to the pilot, but at flight conditions with the largest control power, the nature of the limit cycles changed abruptly to large-amplitude oscillations that could have caused complete loss of control. The frequency and amplitude of the airplane-system limit cycles were calculated by using the describing-function technique together with a nonlinear mathematical model to represent the control system and the airplane. These calculated characteristics compared well with experimental results from flight, ground tests, and simulations. The calculations were repeated for two different electronic filters, the original and a subsequent, improved design, that were incorporated in the stability augmentation system. The calculated limit-cycle characteristics for the final filter did not agree as well with experimental results as did the characteristics calculated for the original filter. Author

N68-11611 Royal Aircraft Establishment, Farnborough (England).

THE CURRENT STATE OF THE SUD-LEAR PROGRAMME TO REDUCE LANDING MINIMA AND DEVELOP AN ALL-WEATHER LANDING SYSTEM [ETAT ACTUEL DU PROGRAMME SUD-LEAR CONCERNANT LA REDUCTION DES MINIMA ET L'ATTERRISSAGE TOUS TEMPS]

J. Lepers, A. Turcat, and P. de Bayser Feb. 1967 39 p Transl. into ENGLISH from Tech. Sci. Aeronaut. Spatiales (Paris), v. 1, 1965 p 19–32

(RAE-LIB-TRANS-1215) CFSTI: $3.00

The Sud-Lear automatic landing system (as fitted in a Caravelle) is described, together with its safety features and monitoring devices. Emphasis is placed on the way the pilots' abilities are utilised in the monitoring of the system. Proposals for future development of safety features are outlined. Author

N68-11627*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LARGE-SCALE WIND-TUNNEL INVESTIGATION OF A MODEL WITH AN EXTERNAL JET-AUGMENTED FLAP

Jerry V. Kirk, David H. Hickey, and Kiyoshi Aoyagi Washington Dec. 1967 35 p refs

(NASA-TN-D-4278) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation has been conducted in the Ames 40- by 80-Foot Wind Tunnel of a large-scale model powered by turbojet engines. The wing had 38.5° sweep of the leading edge, an aspect ratio of 5.38, a taper ratio of 0.23, and a dihedral of 3°. The wings airfoil section was an NACA 65-412. The trailing-edge flaps extended from 8 to 63 percent semispan. A small auxiliary flap spanned the main flap. The exhaust from the engines was directed against the flaps to augment lift. Longitudinal aerodynamic characteristics for various combinations of main and auxiliary flap deflections are shown for thrust coefficients from 0 to approximately 1.4. Limited longitudinal and lateral-directional characteristics are shown for a simulated engine-out condition. Results also demonstrate the feasibility of using the small auxiliary flap as a means of providing direct-lift flight-path control. Author

N68-11638*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT INVESTIGATION OF PERFORMANCE CHARACTERISTICS DURING LANDING APPROACH OF A LARGE POWERED-LIFT JET TRANSPORT

Albert W. Hall, Kalman J. Grunwald, and Perry L. Deal Washington Dec. 1967 27 p refs

(NASA-TN-D-4261) CFSTI: HC $3.00/MF $0.65 CSCL 01D

A flight investigation has been conducted to determine low-speed performance characteristics of an airplane employing a powered-lift system. The airplane used during this investigation was a modified jet transport which was equipped to provide engine compressor air for boundary-layer control over the wing trailing-edge flaps. It was found that for powered-lift aircraft the approach speeds should be based on a given percentage of the power-on stall speeds, but not less than a fixed margin above the stall speeds. These criteria provided adequate maneuver capability for all configurations during instrument approaches. These approach speeds fell slightly below the speeds for maximum lift-drag ratio for all configurations, but this speed-thrust instability caused no objectionable characteristics. Problems encountered during this program which should be considered for operational powered-lift aircraft design were uncomfortable airplane approach attitudes and insufficient thrust margin at low approach speeds and maximum landing weights. Automatic speed control was found to be very effective in reducing pilot workload during instrument approaches. Author

N68-11772*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PREDICTION OF AIRCRAFT SONIC BOOM CHARACTERISTICS FROM EXPERIMENTAL NEAR FIELD RESULTS

Raymond M. Hicks and Joel P. Mendoza Washington Nov. 1967 14 p refs

(NASA-TM-X-1477) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Near field pressure signature data measured in a wind tunnel were used for predicting aircraft sonic boom characteristics. With the data plus the theoretical concepts of Whitham, an experimental area function F(y) could be determined. Evaluation of the area function for the configuration in turn allows an assessment of the sonic boom pressure signature at any distance ratio greater than that used for the original measurement of the near field data. On the basis of limited tests of a 12-inch model of the XB-70 airplane, good correlations of wind tunnel to wind tunnel and wind tunnel to flight pressure signature results were obtained. A near field signature measured at a distance ratio of 1.0 and a Mach number of 1.8 was used to predict the over-pressure characteristics of the XB-70 configuration. The prediction was accurate at a near field distance ratio of 4.5, and a far field distance ratio of 290. Author

N68-11854# Aircraft Research Association, Ltd., Bedford (England).
SUBSONIC AIRCRAFT DRAG: AN APPRECIATION OF PRESENT STANDARDS
A. B. Haines Nov. 1967 45 p refs
(ARA-66) CFSTI: HC $3.00/MF $0.65

The drag at cruise C_L of a number of recent aircraft—mostly large subsonic transports—has been analysed in terms of figures-of-merit derived from Melvill Jones' original concept of a streamline aeroplane. The values have been compared with those for some representative aircraft from the 1930–1940 period. The paper then proceeds to highlight some of the main sources of excess drag for the recent aircraft, these are grouped under broad headings such as "excrescences", "Mach-number effects" and "nacelle installation or interference". The results of the analysis are somewhat disturbing. Perhaps the most striking feature bearing in mind that only a restricted class of aircraft have been considered, is the very wide spread between the figures for the poorest and the best of the recent aircraft. Also, the detailed drag breakdown varies widely from one aircraft to another. The evidence in the paper suggests that in many cases, present drag standards can and should be improved.
Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-11030* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT ON FUEL CELL SYSTEMS Quarterly Progress Report, Jan. 1–Mar. 31, 1968
31 Mar. 1967 162 p
(Contract NAS8-2696)
(NASA-CR-90210; QPR-7) CSCL 10A

Details are presented on the work completed during this reporting period. Research and technological activities are discussed for the following areas: anode catalyst density, matrix water transport rate tests, reactant impurities tests, high and room temperature storage, high-loading electrode test, manifold test, KOH flush of expended fuel cell, and theoretical analysis of shell type heat exchange. Tests of the thermal mockup and advanced thermal design system are described, and it is felt that the system demonstrated the ability to remove rejected heat up to an equivalent fuel cell load of 2.5 kW with a coolant inlet temperature of 100°F and a flow rate of 90 lb/hr. Results of the 2.0 kW fuel cell power system test models are discussed.
N.E.N.

N68-11082# Giannini Control Corp., Malvern, Pa. Astro-mechanics Research Div.
FLUIDIC SYSTEMS DESIGN MANUAL Technical Report, Feb. 15, 1966–Feb. 15, 1967
Charles A. Belsterling Jul. 1967 198 p refs
(Contract DA-44-177-AMC-390(T))
(ARD-DM-052; USAAVLABS-TR-67-32; AD-659415)

The document is a how-to-do-it guide to the design of control systems using analog fluidic devices. It includes reference information on definitions, symbols, and general principles; an integrated set of static and dynamic design methods; and a step-by-step design procedure illustrated with a practical sample problem. The primary purpose of the Design Manual is to provide the control engineer with a unified set of analytical tools for the straightforward design of systems employing fluidic devices. Its secondary purpose is to provide a universally acceptable vocabulary so that the control engineer, the fluidic device manufacturer, and the users project engineer can communicate in a common language. The Fluidic Systems Design Manual contains the following major sections: (1) Introduction, (2) applicable standards, (3) test methods and instrumentation, (4) graphical characteristics of typical fluidic devices, (5) large signal performance analysis, (6) small signal performance analysis, (7) detailed system design procedure, (8) illustrative example of V/STOL control system design.
Author (TAB)

N68-11106* Gulton Industries, Inc., Hawthorne, Calif. Engineered Magnetics Div.
INVERTERS FOR MOTORS STUDY PROGRAM Final Report, Jun. 9, 1966–Jun. 9, 1967
D. B. Irvine 1 Aug. 1967 92 p refs
(Contract NAS8-18013)
(NASA-CR-90300; Rept.-2068) CFSTI: $3.00 CSCL 09C

Several motor and inverter designs were investigated to determine which are most compatible when connected as an inverter–motor combination. The excited synchronous motor which contains slip rings and brushes was excluded due to excessive motor size and weight required. The induction type ac motor presents the most desirable characteristics for general purpose (airborne) application. Inverter output characteristics were studied and the quasi-square wave inverter was selected as the most adaptable for operating the ac motor. The quasi-square wave more nearly duplicates a sine wave and requires no heavy transformer to supply a useable output. An ac 120 volt induction motor was modified to operate with a 31 V RMS Wye or 18 V Delta input. A second 120 VAC motor was modified to operate with an 18 V RMS input, is wired with a Wye winding configuration, and has two interchangeable rotors. Results of tests on inverter motor efficiency, motor torque and slip, and other inverter–motor characteristics are given.
Author

N68-11118# Battery Corp. of America, Fort Lauderdale, Fla.
NEW MAGNESIUM ANODE STRUCTURE Final Report, 1 Mar. 1966–28 Feb. 1967
Rodolfo R. Balaguer Oct. 1967 85 p
(Contract DA-28-043-AMC-01998(E))
(ECOM-01998-F; Rept.-7; AD-659790)

The basic D cell made on this contract has the same construction as that developed on previous contracts except for an improved carbon cup which utilizes a thermosetting resin binder instead of the coal tar pitch formerly used. Thirteen experimental lots were made and put on test to evaluate various materials for the cell jacket, the anode sealing washer and the insulating and reinforcing tape. No definite differences in performance were observed between cells using different materials of construction, except that polyvinyl tape was found to deteriorate at 160F and allow cells to dry out. Nine experimental lots having electrolytes of mixed magnesium and strontium bromides in three molecular ratios and in three normalities, together with magnesium bromide controls, were made to investigate the effects of mixed bromide electrolytes on low temperature performance and delay time. Capacity maintenance at 130F was over 90 per cent at up to five months. Uniformity was good. The feasibility of making a C cell was demonstrated and tools were made to make parts for this size cell using the same design and materials of construction as are used in the D cell.
Author (TAB)

N68-11134*# Monsanto Research Corp., Everett, Mass. Boston Lab.
SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Summary Progress Report, 1 Jul.–30 Sep. 1967

John J. O'Connell, Elizabeth A. McElhill, and Carl A. Olson 30 Sep. 1967 22 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951524)
(NASA-CR-90329; MRB6234Q3; QSR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The following three types of ligand-containing polymers are being developed for use as separator materials in sterilizable silver–zinc batteries: styrene–maleic anhydride copolymers, styrene–maleic anhydride–methyl methacrylate terpolymers, and 40:60 2-vinylpyridine–methyl methacrylate copolymer. The mechanical strength and flexibility of our styrene–maleic anhydride copolymer films has been significantly improved by using uniformly high molecular weight materials. The terpolymers have excellent film properties and are being modified to lower electrical resistivity in 40% KOH. Polymers with higher contents of hydrolyzable acrylate and anhydride groups, were prepared. Insoluble polymers of this type had resistivities from 35 to 70 ohm-in. after sterlization. Polymers with very high hydrolyzable contents had some solubility in electrolyte and are being modified by crosslinking to make them insoluble. Reaction conditions for preparation of the 40:60 2-vinylpyridine–methyl methacrylate polymer were studied to increase their molecular weight. Polymerization to high conversions gave significant increases in molecular weight. Author

N68-11225*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Report, Jul. 1–Sep. 30, 1967
L. C. Scala 30 Sep. 1967 54 p Prepared for JPL
(Contracts NAS7-100; JPL-951525)
(NASA-CR-90330; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A continuous coating apparatus to prepare sterilizable battery separators was built, tested, and put into the production of several feet of separator material which exhibited satisfactory properties. The effect of time of immersion in extractant solution upon separator composites has been investigated using formulations in which the filler was either Zeolon H or coarse zirconia. The best extracting solutions contained dioxane. Generally no correlation was found between separator properties and time of immersion. Author

N68-11322 Joint Publications Research Service, Washington, D. C.
STUDY OF THE OPERATION OF A CESIUM THERMAL EMISSION CONVERTER WITH MOLYBDENUM CATHODE
F. V. Kondratyev, G. V. Sinyutin, and V. F. Tikhonov *In its* Spec. Uses of Electron Microscope and Cesium Thermal Emission Converter 14 Nov. 1967 p 1–9 refs (See N68-11321 02-34)

The results of operating a thermal emission converter using molybdenum as an envelope around the cathode are analyzed along with the regularities inherent in this type of cathode. The experimental results are compared with the phenomenological theory of N. Rasor. R.N.A.

N68-11403* Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
STABILITY AND RESPONSE OF FLUID AMPLIFIERS AND FLUIDIC SYSTEMS Final Report
Forbes T. Brown 1 Oct. 1967 114 p refs
(Contract NAS3-5203)
(NASA-CR-72192; DSR-5169-3) CSCL 13G

The linearized characteristic of fluid amplifiers are represented by admittance matrices which include the self-admittances of the several ports and transfer admittances between the ports. Stability criteria and response relations are given in terms of these matrices. The frequency-dependent elements of the matrices were measured for a proportional jet amplifier using piezo electric and hot-wire instrumentation. An alternative technique used acoustic testing and measurement of standing wave patterns. A principal conclusion is that data of this type can be very useful in fluidic circuit design. If rational or primitive-element models can be formed from the data, computer simulation techniques could greatly streamline the design and optimization of fluidic sub-systems and systems. Author

N68-11490*# Fairchild Hiller Corp., Rockville, Md. Space Systems Div.
POSITIVE DEPLOYABLE SOLAR ARRAY DEVELOPMENT PROGRAM Final Report, 1 Jul.–30 Sep. 1964
30 Sep. 1964 149 p
(Contract NAS5-3988)
(NASA-CR-90347; SSD-52-4) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This final report presents the results of a study to select an optimum design for a compact storable solar array system for use with spin stabilized satellites. In this study several concepts of both flexible and rigid solar panels were considered. The elimination of less favorable concepts were made on the basis of minimum weight, high power to weight ratios, environmental compatibility, reliability, minimum packaged volumes, state-of-the-art materials and moderate cost. The study has culminated in a final design using a flexible substrate with a scissors type extension mechanism. The scissors are driven by spring loaded screw jacks and controlled during deployment by a centrifugal brake mechanism. A dynamic, thermal and a structural analysis of the final configuration is included. Author

N68-11503# Monsanto Research Corp., Everett, Mass. Boston Labs.
FIVE-KILOWATT HYDRAZINE/AIR FUEL CELL MODULES Final Technical Report, 9 Apr. 1965–24 Jul. 1966
Robert E. Salathe and Peter L. Terry 10 Jun. 1967 35 p
(Contract DA-44-009-AMC-983(T))
(MRB4026F; AD-659813)

Fuel cells based on an initial conceptual design for a 5-kilowatt N_2H_4/KOH/air fuel cell were constructed and operated. A development program was conducted in which factors causing operational difficulties were identified, and appropriate modifications of the design and choice of materials were then made. TAB

N68-11544# Aeronutronic, Newport Beach, Calif.
STREAM POWERED GENERATOR Final Report
25 Jul. 1967 64 p refs
(Contract Nonr-4826(00))
(AD-660009)

The stream powered generator consists of a propeller driven housing which contains a directly driven permanent magnet alternator, voltage regulator, bearings and shaft seals, and oil supply for lubrication and heat transfer. The rotating assembly is attached to the mounting stake via the stationary shaft through which the electric cable is routed. The mounting stake is equipped with a swivel joint allowing the unit to be self aligning with the direction of the stream flow. The unit will deliver 50 watts at 24 volts plus or minus 1% when driven by a 4.0 knot stream of water. The unit weighs 14.5 pounds and has a maximum propeller diameter of 22.5 inches which is suitable for operation in the maximum 2-foot stream depth specified. The high speed propeller blades are swept back in the plane of rotation and also slightly in the direction of the free stream to minimize the effect of drifting vegetation. The material used in the construction of the generator housing, propeller blades and mounting stake is 6061-T6 aluminum. The aluminum parts have been hard black anodized to provide mechanical abrasion resistance, increase atmospheric corrosion resistance and also minimize the effect of galvanic action due to the incorporation of dissimilar materials. TAB

N68-11646# Naval Ordnance Lab., Corona, Calif. Research Dept.
CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERIES Quarterly Report, Jan.–Mar. 1967
1 Oct. 1967 23 p refs
(NOLC-738; QR-15; AD-660362)

The effects of H2S and NH4(+) on the reduction of sulfur in NH3 solutions were investigated and both were found to be beneficial. The effects of various cathode materials and acid strengths on the reduction of M–DNB were also investigated and sulfamide and cyanamide were found to favorably affect the reduction of M–DNB, while urea did not. Various electrode materials were tested in acid liquid ammonia to determine their value as catalysts for the electrochemical oxidation of carbonaceous fuels. Titanium and tantalum were found to offer wide potential ranges and good resistance to electrode corrosion. Methanol was tested in liquid NH3–NH4SCN for possible oxidation on various electrode surfaces, but no activity was observed in liquid ammonia solutions. Author (TAB)

N68-11649*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF AMMONIUM HYDROGEN SULFIDE AND FREON 14 ON SILICON SOLAR CELLS
Frank W. Gilleland Oct. 1967 24 p refs
(NASA-TM-X-63039; X-716-67-522) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The electrical output and the mechanical condition of silicon solar cells with titanium silver grids and contacts has been studied in atmospheres which could be created by proposed spacecraft attitude control systems. The effects on silicon solar cells of atmospheres of ammonium hydrogen sulfide at temperatures ranging from −20°C to +20°C and atmospheres of Freon 14 gas have been investigated. Experimental results indicate that no short-term degradation of solar arrays which use silicon cells with titanium silver grids and contacts is to be anticipated as a result of exposure to these gases. Author

N68-11794*# Monsanto Research Corp., Everett, Mass. Boston Lab.
RESEARCH AND DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Final Report, 9 Jun. 1965–1 Mar. 1967
John S. Driscoll, David L. Williams, Alexander S. Borsanyi, and Joseph J. Byrne 26 Apr. 1967 231 p refs
(Contract NAS3-7624)
(NASA-CR-90547) CFSTI: HC $3.00/MF $0.65 CSCL 10C

High energy couple research, tape cell evaluation, and supporting research are reported. In the non-aqueous couple research, a Li/$LiClO_4$-methyl formate/dichloroisocyanuric acid cell was developed and it delivered 213 watt-hr/lb at a constant 3.2 volts. An aqueous cell was also developed which is composed of Mg/$MgBr_2$ trichloroisocyanuric acid, and it delivered 115–120 watt-hr/lb at a constant 2.0 volts. Details are presented on the anode and cathode research and energy densities for these cells. The evaluations of the cathode preparation for both the aqueous and non-aqueous cells are discussed. The dynamic test program for active halogen and oxygen cathodes is described, and dynamic tests of the tape system for the aqueous cell were successful for periods of four hours at 2.0 volts and 15 ma/cm^2. N.E.N.

N68-11804*# Gulton Industries, Inc., Metuchen, N. J.
INVESTIGATION OF STERILIZATION OF SECONDARY BATTERIES Final Report, Oct. 28, 1965–Jun. 28, 1966
John Liska 28 Jun. 1966 36 p
(Contract NAS1-5708)
(NASA-CR-90501) CFSTI: HC $3.00/MF $0.65 CSCL 10C

This is the final report of an eight-month study to develop a nickel–cadmium cell thermally sterilized at 145°C and yielding a power density and cycle life approaching that of present state-of-the-art nickel–cadmium cells. A number of existing separator systems are evaluated; the more sterilization resistant types being incorporated into cells. Two asbestos systems and one polypropylene separator system appear the most promising. Tests indicate that the nickel plate contributes to the capacity loss while the negative plate limits the overchange capability following thermal sterilization. X-ray spectrographs of the nickel-plate before and after sterilization are shown. Author

N68-11827* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
FUEL CELL RELIABILITY ASSESSMENT Quarterly Progress Report, 8 Jul.–8 Oct. 1967
R. P. Bruno 25 Nov. 1967 31 p
(Contract NAS8-2696)
(NASA-CR-90524; QPR-2002) CFSTI: $3.00 CSCL 10A

A reliability assessment program directed toward the determination of fuel cell stack performance under high stress conditions and toward the establishment of reliable operating limits is reported. Each fuel cell stack tested is a 28 volt 2 kw hydrogen–oxygen alkaline unit. Life testing demonstrated that continuous operation at a constant load is not detrimental to performance. Installation of flow restrictors in the oxygen plate inlet port and maintenance of a constant electrolyte volume improved performance; the voltage degradation rates for the stacks before and after installation are summarized. Objectives for the low power life, thermal cycle, high power life, endurance, centerline performance, and stress performance tests are outlined; and results are reported. S.P.

N68-11839* Douglas Aircraft Co., Inc., Newport Beach, Calif. Missile and Space Systems Div.
SEALING OF SILVER OXIDE–ZINC STORAGE CELLS Quarterly Report, 23 Jun.–23 Sep. 1967
23 Sep. 1967 34 p refs
(Contract NAS5-10409)
(NASA-CR-90523; DAC-59860-Q1; QR-1) CFSTI: $3.00 CSCL 10C

As an initial step toward evaluating the use of miniature hybrid fuel cells for controlling pressure and permitting operation of hermetically sealed silver oxide–zinc cells, design studies and tests were conducted on micro fuel cells. It was found that silver oxide cells with 1.0 cm^2 electrodes were capable of consuming hydrogen at rates over 80 cc H_2/hour for less than one hour, and at rates up to 20 cc H_2/hour for hundreds of hours. Based on the weight of the silver oxide, efficiencies ranged from 60% to 90%. Efficiencies of cadmium micro fuel cells ranged from 35% to 40% based on weight of cadmium. Preliminary data are included on gassing by volumetric analysis on the commercial silver oxide–zinc cells. The observed gassing rates are considered to be within the gas consumption capabilities of the silver oxide and cadmium micro fuel cells, and no special problems are anticipated in operating hermetically sealed silver oxide–zinc cells with the micro fuel cells. M.G.J.

N68-11857*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT ON FUEL CELL TECHNOLOGY Quarterly Progress Report, Apr. 20–Jul. 20, 1967
H. Bjorkman Oct. 1967 53 p refs
(Contract NAS8-20573)
(NASA-CR-90502; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Work is described which seeks to develop a fuel cell module with improved reliability, life, and performance for application in earth orbit, lunar orbit, and on the lunar surface. A thermal analysis was conducted of the use of reactant gas expansion energy for compressive pumping to increase the product water vapor

condensation temperature, thereby improving the fuel cell heat rejection capability. Other pumping efficiencies were also briefly considered. Recirculated KOH heat and water removal methods were studied to establish a design basis for a breadboard fuel cell system. A Luggin capillary, which in effect places a reference electrode between the anode and cathode, was installed in one cell of a single section test unit to measure individual operating anode and cathode potentials as a function of reactant pressure and fuel cell temperature. Several new electrodes were evaluated, and a vacuum loading method for impregnating the electrodes with electrolyte was studied. The effect of total electrolyte volume available in the cell upon fuel cell life and performance was determined. K.W.

N68-11891 Siemens-Schuckertwerke A.G., Erlangen (West Germany).
THERMOELECTRICITY IN SPACE TRAVEL [THERMOELEKTRIZITAET IN DER RAUMFAHRT]
Eugen von Szabo 1966 28 p refs In GERMAN Sponsored by Bundesmin. fuer Wiss. Forsch.
CFSTI: $3.00

Requirements and state-of-the-art of thermoelectric power sources for space application are reviewed. The principles of construction of thermoelectric generators, construction elements, performance parameters, their use as heat sources, and radiator designs are discussed. Thermoelectric materials are briefly covered, including their effectiveness, high-temperature aspects, bridge materials, and advantages of germanium–silicon alloys. Radionuclide generators and reactor systems are included in the review. Transl. by K.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-11008* Texas Inst. for Rehabilitation and Research, Houston.
USE OF EXTREMITY CUFFS AS A CARDIOVASCULAR REFLEX CONDITIONING TECHNIQUE
Fred B. Vogt Mar. 1967 232 p refs
(Contracts NSR-44-024-006; NAS9-1461; NAS9-5821; Grant NIH FR-00254)
(NASA-CR-90248) CSCL 06P

Tilt table study and plasma volume data are presented on the Gemini V and VII astronauts who participated in the cardiovascular reflex conditioning experiment. Ground-based experimental results are also included to indicate the effect of extremity cuffs in the simulated flight conditions of water immersion and bedrest. A cuff inflation–deflation cycle of 2 minutes on, 4 minutes off was used 24 hours a day during orbital flight. An effective inflation pressure of 80 mm Hg to the cuffs was utilized; it took approximately 10 seconds for inflation of the cuff and 10 to 12 seconds for deflation once the pressure source was removed. Based on the data analyses, it was concluded that no significant protection against cardiovascular deconditioning associated with bedrest of water immersion experiments, or with space flight, can be attributed to the use of intermittently inflated extremity cuffs. M.G.J.

N68-11035*# California Univ., Berkeley. Space Sciences Lab.
CHEMISTRY OF LIVING SYSTEMS Semiannual Report, Apr. 1–Sep. 30, 1967
Thomas H. Jukes 30 Sep. 1967 35 p refs *Its* Space Sci. Lab. Ser. 8, Issue 91
(Grant NsG-479)
(NASA-CR-90308) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Brief reports are presented on biochemical research projects. Studies are described on DNA replication and RNA polymerase; chemical and optical properties of nucleic acids and proteins; sequential studies of spinach and chromatium ferredoxins, and thermolysin; function and structure of bacterial ribosomes; formation of bacteriophage T4; regulation of nucleoside metabolism; bacteriophage internal proteins; and action of various mutagens on TMV and TMV-RNA. N.E.N.

N68-11042# Technology, Inc., San Antonio, Tex. Life Sciences Div.
THE INVESTIGATION OF THE PARAMETERS OF HEAD INJURY RELATED TO ACCELERATION AND DECELERATION Final Report, 1 Jul. 1964–30 Jun. 1966
Lawrence S. Higgins, Robert A. Schmall, Clarence P. Cain, Philip E. Kielpinski, Frank P. Primiano, Jr. et al Jun. 1967 111 p refs
(Contract DA-49-193-MD-2610)
(TI-118-67-1; AD-659795)

The report describes the results of a three year program in experimental head injury. During this period a highly successful head accelerating device was evolved. Major features of this machine include the application of a reproducible non-deforming stimulus to the head through a controlled path. A series of head acceleration experiments were conducted with this machine. Graded stimuli from no effect through concussion to lethality were found possible without deformation of the skull. Because of the reproducible acceleration waveform produced by this machine, statistical ranking of clinical signs of concussion is possible and is reported. From these experiments, clinical data as well as gross pathological findings are summarized. Detailed design criteria for the head accelerator are included in this report, as well as the associated instrumentation. Conclusions regarding the engineering and physiological findings are followed by recommendations for further work. Author (TAB)

N68-11050# Florida Univ., Gainesville.
EFFECTS OF PROLONGED STAGE FOUR AND 1-REM SLEEP DEPRIVATION: EEG, TASK PERFORMANCE, AND PSYCHOLOGIC RESPONSES
Robert L. Williams, H. W. Agnew, Jr., and Wilse B. Webb Brooks AFB, Tex. School of Aerospace Med. Jul. 1967 17 p refs Submitted for publication
(Contract AF 41(609)-2907)
(SAM-TR-67-59; AD-659764)

Two experiments are described which demonstrated the effects of extended stage 4 sleep deprivation and separately the effects of 1-REM sleep deprivation. Measurements of the sleep EEG and measurements of personality variables revealed that these two types of sleep deprivation are quite different. Stage 4 deprivation resulted in a sharp increase in stage 2 on deprivation nights while 1-REM deprivation resulted in an increase in stage 1 without rapid eye movements. Stage 4 deprivation produced a depressive psychologic profile in the subjects while 1-REM deprivation resulted in a state of increased irritability and emotional lability. TAB

N68-11065* Texas Inst. for Rehabilitation and Research, Houston. Medical Center.
THE USE OF TILT TABLE STUDIES TO EVALUATE CARDIOVASCULAR DECONDITIONING OF SPACE FLIGHT
Fred B. Vogt Mar. 1967 120 p refs
(Contract NSR-44-024-006; Grant NIH FR-00254)
(NASA-CR-90251) CSCL 06S

An evaluation is made of tilt table studies performed in association with the Gemini space flights which describe the cardiovascular deconditioning associated with space flight. The analysis and interpretation of the data is based on experience from extensive tilt table studies performed in association with water immersion, bedrest, and chair rest deconditioning experiments. The study shows that cardiovascular deconditioning, as evidenced in heart rate and blood pressure response to the tilt procedure, does occur in association with space flight. The deconditioning may be due to changes in several physiological systems. There is no strong evidence of space flight time dependence in producing the deconditioning. There is an apparent difference in cardiovascular deconditioning of bedrest, water immersion, and space flight. The occurrence of syncope was no greater after period of space flight deconditioning than for a normal population undergoing other experimental circumstances. No single measure or index was derived which can express an individual's specific tilt table response in relation to his normal response, or to the response of a population. R.N.A.

N68-11078# School of Aerospace Medicine, Brooks AFB, Tex.
MOL: PREDICTING FOUR-HOUR LEVELS OF PSYCHOMOTOR PERFORMANCE FROM THE INITIAL HALF HOUR
Bryce O. Hartman Jun. 1967 15 p Submitted for publication
(SAM-TR-67-55; AD-660103)

Four subjects participated in an MOL-like nutrition study using freeze-dehydrated, bite-sized Apollo food. The two experimental subjects were confined in a small (300 cu. ft.) altitude chamber operated at 27,000 feet with an atmosphere of 70% oxygen and 30% helium. Psychomotor testing was conducted in 4-hour sessions three times a day, every other day, alternating with two control subjects. No major psychomotor changes were observed, except on the short-term memory task, which appeared to reflect motivational factors. Correlations between the first half hour and the remainder of the testing session ranged from -.21 to +.96 and were scattered across that range. It was concluded that a daily half-hour psychomotor test of space crews is probably not sufficiently stable to meet biomedical monitoring requirements. Author (TAB)

N68-11141*# Pennsylvania State Univ., University Park. Physiology Labs.
INTESTINAL ABSORPTION OF RADIOIODIDE IN RATS EXPOSED TO HYPOXIA (380 MM HG) AND FOOD DEPRIVATION
Peter F. Pearson and Adam Anthony Sep. 1967 45 p refs Sponsored by Natl. Inst. of Gen. Med. Sci. and NIH
(Grants NGR-39-009-015; PHS GM-05112)
(NASA-CR-90307) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Hypoxia effects on gastrointestinal absorption of orally administered radioiodide and the extent of its influence on circulating and thyroidal iodide levels were investigated. Two experiments were performed using adult male Holtzman rats. In the first, 12 rats were placed in a decompression chamber for 24 hours while 12 controls were kept at ambient pressures. Both groups were fed *ad libitum*. In the second experiment, 24 rats were deprived of food for 24 hours; 12 of these were then subjected to hypoxia for 24 hours while the remaining 12 were kept at ambient pressure as food-deprived controls. In all instances, 0.2 μc NaI-131 was given orally 24 hours before killing the rats. In both experiments, hypoxic rats had more food and radioiodide remaining in the stomach than ambient pressure controls, indicating hypoxia causes a delay in the movement of gastric food and iodide into the intestine. Food deprivation alone had no effect on gastric or intestinal levels of radioiodide, indicating no appreciable impairment in iodide absorption. Circulating levels of radioiodide were comparable in control and hypoxic rats despite a lowered intestinal absorption in hypoxic animals. This was partly due to an hypoxia-induced reduction in urinary excretion of radioiodide. E.C.

N68-11167* Detroit Univ., Mich. Dept. of Behavioral and Neurological Sciences.
THE ANALYSIS OF GEMINI 7 EEG DATA BY THREE DIFFERENT COMPUTER ORIENTED METHODS
[1967] 56 p refs
(Contract NSR-23-003-005)
(NASA-CR-90235) CSCL 06S

The problem in assessment of electroencephalograms has been the subjective element in visual evaluation of such records as well as the need for extensive training (2 to 3 years) before a suitable candidate is capable to perform this task. There have been a variety of computer type analyses of EEG during the past ten years or more, and we are still searching for a reliable, inexpensive, on-line data processing procedure for this task. We are aware our Soviet colleagues are routinely using computer assessment of EEGs, using relatively inexpensive hardware. In our report we endeavor to show how four different assessment procedures (visual assessment, zero crossings technique, smoothing and peak counting technique, and Weibull Statistic) may be utilized, and indicate the advantages and disadvantages peculiar to each. We wish to point out that in the Gemini 7 EEG analog records supplied to the Henry Ford Hospital, Channal II (mid-line central to mid-line occipital electrodes) could not be assessed reliably after approximately 26 hours of flight. Channel I (left central to left occipital electrodes) provided the more assessable EEG up to approximately 54 hours of flight. These channels were compared during the first 26 hours of flight, and no significant difference was found by our various assessment procedures. We, therefore, have limited this report to the findings on the analyses of Channel I during its approximate 54 hours of recording. Author

N68-11177# Pisa Univ. (Italy). Istituto di Fisiologia.
COMPARATIVE NEUROPHYSIOLOGY OF THE VISUAL SYSTEM Final Scientific Report, 15 Sep. 1966–14 Sep. 1967
Giuseppe Moruzzi 14 Sep. 1967 11 p refs
(Contract F61052-67-C-0028)
(AFOSR-67-2354; AD-659763)

The following themes were investigated: Reticular influences on the lateral geniculate body; Peripheral inhibition of flashing in fireflies; Influence of background illumination on the electrical responses of the cats retina to flashes of light; Dark adaptation and equivalent background responses in the cats retina; The electroretinogram of the pigeon; Visual receptive fields of callosal units; Interactions between callosal and geniculo-cortical inputs to the visual cortex. TAB

N68-11212# Naval Air Development Center, Johnsville, Pa.
MATHEMATICAL MODEL OF SKIN EXPOSED TO THERMAL RADIATION
John A. Weaver and Alice M. Stoll 22 Aug. 1967 34 p refs
(NADC-MR-6708; AD-659973)

Prediction of dermal injury resulting from exposure to thermal energy of any given intensity and duration depends entirely upon the resultant skin temperature-time history. Means are now available for assessing heat transfer by low temperature radiation, convection and conduction to the bare skin and through thin protective coverings of known physical properties. However, thermal effects of nuclear detonations constitute a special problem because much of the radiation lies in the visible range where the optical properties of the skin and its coverings, if any, greatly influence the heating pattern. Blackening of the skin eliminates effects due to its optical properties but enhances the ever-present variations in the thermal constants of the skin. The present report describes the utilization of a mathematical equation and computer techniques for extracting these variations from empirical data obtained at relatively low levels of radiation (<0.5 Cal/sq cm sec.), and applying extrapolations of these values in calculations of temperature-time histories at higher levels of irradiance where empirical data are lacking. This procedure is subject to validation by experimentation within a

limited range of exposures. If validation is achieved in the blackened skin then the entire system may be utilized in the determination of optical properties of unblackened skin. Author (TAB)

N68-11224* Texas Inst. for Rehabilitation and Research, Houston.
BLOOD VOLUME STUDIES IN ASSOCIATION WITH GEMINI SPACE FLIGHTS
Fred B. Vogt Mar. 1967 70 p refs
(Contract NSR-44-024-006; Grant NIH FR-00254)
(NASA-CR-90234) CSCL 06S

Preflight and postflight plasma volume and red cell mass measurements on Gemini astronauts are evaluated. Single 15 minute mixed isotope samples were used. The measurements were primarily recorded to determine the effects of prolonged flights. The astronauts were weighed preflight and postflight, urine volume measurements were taken during flight, and tilt table studies were performed preflight and postflight. Comparisons are made between blood volume and hematocrit changes in individual astronauts and data on ground-based subjects. A literature survey on blood volume changes during experimental studies on normal subjects is also presented. E.C.

N68-11246# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
HUMAN BIOLOGICAL INTERACTIONS WITH LASER LIGHT Research Report, Nov. 1966–May 1967
T. O. Huston 2 Aug. 1967 36 p refs
(NELC-1502; AD-660361)

The report discusses the effect of laser light on the human body, particularly the eye. It includes calculations of the results to be expected for some common commercial gas lasers. Emphasis is placed upon low power lasers which are the most frequently mishandled. Author (TAB)

N68-11285*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE DISPERSION AND DISSIPATION OF WAVES IN BLOOD VESSELS
James A. Maxwell and Max Anliker May 1967 115 p refs Sponsored in part by NASA
(Contract DA-31-124-ARO(D)-233; Grant NSFGK-47)
(NASA-CR-90377; SUDAAR-312; AD-659787) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Dispersion and dissipation phenomena associated with waves propagating in blood vessels are potential measures of the distensibility of the vessels and other cardiovascular parameters. In this investigation we assume the vessels to behave like thin-walled circular cylindrical shells filled with an inviscid compressible fluid. The vessel wall is assumed to have isotropic and homogeneous viscoelastic properties. The waves are described by small three-dimensional displacements of the middle surface of the shell from an equilibrium configuration defined by a mean transmural pressure and an initial axial strain. The fluid motion associated with the waves is considered as irrotational. The linearized differential equations of motion are based on the shell equations derived by Flugge. Author (TAB)

N68-11290*# Miami Valley Hospital, Dayton, Ohio.
COMPARISON OF ORGANOLEPTIC ACCEPTABILITY OF LIQUID AND FRESH DIETS
Vickie R. Must, Carol A. Linder, Dorathea P. Dunco, Keith J. Smith (AMRL), and Elwood W. Speckmann (AMRL) Wright-Patterson AFB, Ohio AMRL Jun. 1967 16 p refs Presented at the 48th Ann. Meeting of the Am. Dietetic Assoc., Cleveland, 1–5 Nov. 1965
(NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-90379; AMRL-TR-65-179; AD-660136) CFSTI: HC $3.00/MF $0.65 CSCL 06H

Data on the organoleptic acceptability of a liquid diet formula with a variety of flavors and two other diets composed of fresh foods was obtained from eight subjects during two, forty-two day experiments. An analysis of the acceptability ratings permits the following conclusions to be made: (a) Even when variety is limited, the acceptability of a fresh food diet is considerably higher than the acceptability of a liquid formula when given as the sole source of nutriment. (b) The bittersweet chocolate-flavored beverage was preferred over the other flavors. (c) Differences inherent among individuals cause statistically significant variation in food acceptability ratings. (d) Over an extended period of time, monotony may be overcome by incorporating a liquid formula into a diet composed primarily of solid foods. This approach merits further investigation. Author (TAB)

N68-11325# School of Aerospace Medicine, Brooks AFB, Tex.
DEFINITION OF SPACE FLIGHT MEDICAL KITS: A RATIONALE
James F. Wittmer Jun. 1967 20 p
(AMD-TR-67-1; AD-659761)

A systematic approach to the identification of on-board medical therapeutic items for manned space flight is described. Included are a resume of the mission-spacecraft-crew specific factors to be considered, and a discussion of the correlative process needed to assess and integrate the many variables involved. The rationale is illustrated by data from a study using the described techniques, the requirement having been the definition of medical kit items for a manned space flight of several weeks duration. Author (TAB)

N68-11380*# Texas Inst. for Rehabilitation and Research, Houston.
BONE DENSITY AND CALCIUM BALANCE STUDIES ON PROJECT GEMINI
Fred B. Vogt Mar. 1967 113 p refs
(Contract NSR-44-024-006; Grant NIH FR-00254)
(NASA-CR-90218) CFSTI: HC $3.00/MF $0.65 CSCL 06P

An attempt is made to evaluate and relate bone density, calcium balance, and nitrogen balance studies that were performed in association with Gemini space flights to observations made from ground-based studies. Experiments are described in which data were obtained on the effects of space flights of up to 14 days duration on the skeletal and muscular systems. Appendices are included which cover (1) a bone densitometer assembly for measurements of roentgenographic bone density, (2) reproducibility of an X-ray bond densitometry technique, (3) human evaluation of a chemical urine volume and measurement system, and (4) calcium balance in association with a 30 day bedrest study. C.T.C.

N68-11508# Stanford Univ., Calif. Biophysics Lab.
INDUCTION EFFECTS IN EPR SIGNAL I IN ALGAE
Ellen C. Weaver 1 Aug. 1967 10 p refs Presented at Conf. on Comp. Biochem. and Biophys. of Photosynthesis, Hakone, Japan, 12–15 Aug. 1967
(Contract AT(40-3)-326-12)
(SU-326P12-8) CFSTI: HC $3.00/MF $0.65

The kinetics of the appearance of EPR Signal I in whole cells parallel those for the oxidation of P_{700} and cytochrome. Electron parametric resonance spectroscopy of wild type algae was found to allow the study of the photoreactive center I without interference from overlapping pigments, since the detecting microwave radiation does not itself affect any photosynthesis processes. Author (NSA)

N68-11758*# Naval School of Aviation Medicine, Pensacola, Fla.
EXPOSURE OF MAN TO LOW INTENSITY MAGNETIC FIELDS IN A COIL SYSTEM

Dietrich E. Beischer, Earl F. Miller, 2, and James C. Knepton, Jr. 3 Oct. 1967 31 p refs Prepared jointly with NASA
(NASA Order R-39)
(NASA-CR-90223; NAMI-1018) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The magnetosphere is an intrinsic component of the earth environment, and travel beyond this sphere will expose man to near absence of a magnetic field. The present study is a continuation of a previous investigation of the physiological and psychological effects of prolonged exposure of man to low intensity magnetic fields. In support of previous findings, a significant gradual decrease of the scotopic flicker fusion threshold was observed from which the subjects recovered after exposure. Problems of life in a magnetic field-free environment are discussed. Author

N68-11781 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
COMPARISON OF THE RESULTS OF SOME CARDIOVASCULAR TESTS AND A HYPOXIC TOLERANCE TEST IN YOUNG UNTRAINED MALES [VERGLEICH VON KREISLAUFFUNKTIONSPRUEFUNGEN UND SAUERSTOFFMANGEL-BELASTUNGSTOLERANZ BEI UNTRAINIERTEN JUNGEN MAENNERN]
K. S. Chalkhaeuser Oct. 1967 49 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-67) CFSTI: $3.00

The physical fitness of 20 nonathletic young males was determined by five tests, measuring the response of the cardiovascular system to dynamic exercise (the Harvard-step-up-test, the Hettinger–Rodahl step-test and the "Leistungspulsindex" of E. A. Müller) and/or to change of position (the Schellong and the Schneider test). In addition, the tolerance to lowered atmospheric pressure in the same group was evaluated. While comparing the results of these tests by statistical methods, a positive correlation could only be found between the two step-tests. On the other hand, the criteria of hypoxic tolerance showed a high but negative correlation to the cardiovascular tests, the "Leistungspulsindex" excepted, which showed no correlation at all. Author

N68-11808*# Minnesota Univ., Minneapolis. School of Public Health.
METHODOLOGY OF MEASURING INTERNAL CONTAMINATION IN SPACECRAFT HARDWARE Final Report
V. W. Greene, Bailus Walker, Jr., and Orin A. Anderson Jun. 1967 60 p refs
(Grant NGR-24-005-063)
(NASA-CR-90533) CFSTI: HC $3.00/MF $0.65 CSCL 06T

An investigation was made to determine (1) the most appropriate methods for recovering inoculated spores from a number of different solids, (2) the reproducibility and precision that can be obtained with these methods, (3) the effects of surface sterilization treatments on occluded contamination, and (4) how long the occluded contaminants survive under different storage conditions. Emphasis was placed on occluded contaminants in polymerizable plastics. A number of side issues were studied, such as the probability of release of embedded spores during impact, and the optimal methods of artificially inoculating and culturing certain solid materials. A summary of significant results and conclusions, and a delineation of anticipated problem areas and recommended actions are included. C.T.C.

N68-11836* Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
[INVESTIGATIONS IN SPACE-RELATED BIOLOGY, INCLUDING MOLECULAR EVOLUTION AND RELEVANT ASPECTS OF THE EXTRA-TERRESTRIAL ENVIRONMENT] Annual Report, 1 Oct. 1966–30 Sep. 1967
30 Sep. 1967 78 p refs
(Grant NsG-689)
(NASA-CR-90535; AR-3) CFSTI: $3.00 CSCL 06C

The activities and organizational structure of the Institute are reviewed, and summary data are provided on the various research projects being conducted. These include (1) the position of proteinoid microspheres in the continued development of a theory of abiogenesis; (2) amino acid compositions of hydrolyzates of volcanic samples; (3) sequences in thermal polyanhydroamino acids; (4) thermal synthesis of a polymer with MSH activity; (5) catalytic activities in proteinoids; (6) polymerization in proteinoid microspheres; (7) proteinoid in the photocatalysis of model prebiochemical reactions; (8) catalysis and photocatalysis of decarboxylation of glyoxalate in presence of proteinoids; (9) physiology of reproduction; and (10) organic chemical studies of the carbonaceous constituents of meteorites. M.G.J.

N68-11837* Albert Einstein Coll. of Medicine, New York.
THE EFFECTS OF ISOLATION, SENSORY DEPRIVATION, AND SENSORY REARRANGEMENT ON VISUAL, AUDITORY, AND SOMESTHETIC SENSATION, PERCEPTION, AND SPATIAL ORIENTATION Annual Report, Sep. 1, 1964–Aug. 31, 1965
Sidney Weinstein 31 Aug. 1965 205 p refs
(Grant NsG-489)
(NASA-CR-90498) CFSTI: $3.00 CSCL 06S

Details are given on an experiment dealing with the independent variables of 72 hours of total deprivation of movement, auditory, visual, and somesthetic sensation, and social isolation upon various dependent variables. These dependent variables were a variety of absolute and difference sensory thresholds, and various cognitive, motor, and physiological measures. A series of experiments were conducted to test the assumption that adaptation to a visually rearranged environment results from information on the rearranged environment being fed to the individual. It was further assumed that the source of this information need not be self-induced movement (reafference). The effectiveness of informational feedback in producing adaptation was compared to the degree of adaptation resulting from the effects of self-induced movements. The findings indicate that informational feedback, exclusive of reafference, was either equally effective in producing adaptation to rearrangement or somewhat superior. An extensive bibliography on sensory deprivation and related areas is included. M.G.J.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-11019*# California Univ., Los Angeles. Research Div.
SMALL GROUPS AND THE PREDICTION OF BEHAVIOR
Fred Massarik Sep. 1967 19 p refs
(Grant NGR-05-007-090)
(NASA-CR-90247; NASA-RP-22) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Major modes of interpersonal prediction, managerial style in prediction process, and an integrative mode to improve interpersonal predictive outcomes are discussed. Experiential, normative, and research predictions are described. Parallel and separatists modes of dealing with small groups from the manager's vantage point are outlined. An integrative learning/teaching model is suggested that is based on multivariate problems which are socially relevant and interplay among the many forces affecting the small group behavior. N.E.N.

N68-11020*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DEVELOPMENT OF PROTOTYPE MASS MEASUREMENT SYSTEM FOR SPACEFLIGHT, PHASE II
R. B. Maine and A. L. Weitzmann 9 Nov. 1967 75 p
(Contract NAS1-7135)
(NASA-CR-66479) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Based on the principle of the simple harmonic motion of an oscillating mass, coupled with the precise timing of the oscillations, a prototype mass measurement system (MMS) was designed and fabricated. The conventional ball bearing cluster carriage assembly was used, together with a pallet assembly designed to meet the structural requirements of the 2.5 g loads imposed when flying the zero gravity parabola. Details are given on the inanimate and man restraint systems, and on the otolith threshold measurement techniques. Tests of rigid masses from 5 to 250 pounds, and of three human subjects, proved accurate, and the MMS was converted into the acceleration threshold measurement configuration and test flown using two subjects. The results indicate that the device can determine man's threshold to accelerations in the area of 5 cm/sec^2 in the zero gravity environment. M.G.J.

N68-11090# General Electric Co., Binghamton, N. Y. Avionic Controls Dept.
A BLENDED FEEDBACK VARIABLE FOR CONTROL AUGMENTATION SYSTEMS Technical Report, May 1966–Apr. 1967
Donald T. Makers Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Aug. 1967 40 p refs
(Contract AF 33(615)-5371)
(ACD-8317 AFFDL-TR-67-87; AD-659753)

A man-airframe disturbance sensitivity model has been postulated. The existence of optimum pilot chosen compensation in the multiloop compensatory mode is shown to result in minimum closed loop sensitivity to pilot induced stick input errors. Based on existing fixed base simulator data it is shown that an optimum ratio exists for blended feedback control of pitch rate and normal acceleration. Author (TAB)

N68-11097# Naval Personnel Research Activity, San Diego, Calif.
THE APPLICATION OF DECISION THEORY AND SCALING METHODS TO SELECTION TEST EVALUATION
Ervin W. Curtis Feb. 1967 112 p refs
(STB-67-18; AD-659961)

The correlational approach to selection test evaluation was examined and found to have serious limitations. An approach based on statistical decision theory was developed. Two new methods were presented, one called the utility function method and the other the decision-theoretic method. The former involves the comparison of criterion groups in terms of their utility to the institution using the selection test. The decision-theoretic method is based on statistical decision theory and involves the construction of a payoff matrix corresponding to the contingency table relating the test to the criterion. The cell frequencies are weighted in a utility equation by the payoff values in the corresponding cells of the payoff matrix. This utility equation represents a new test evaluation index which directly expresses the utility of the test to the institution using it. Both of these new methods require the measurement of values peculiar to the institution using the test. The utility function method requires that the performance criterion be translated to a utility function; while the decision-theoretic method requires that a payoff matrix be developed which reflects the gains and losses each cell observation represents to the institution. The three methods (correlational, utility function, and decision-theoretic) were compared with tests used to select students for A-Schools in the U.S. Navy. The three methods led to quite different indications regarding the utility of the selection tests evaluated. The two new methods agreed in terms of the proportion improvement over chance prediction provided by the tests while the correlational method tended to underestimate this proportion. TAB

N68-11164# Ohio State Univ., Columbus. Human Performance Center.
INFLUENCE OF PROLONGED VIEWING OF LARGE-SCALE DISPLAYS ON EXTRACTION OF INFORMATION Final Report, May 1966–May 1967
William A. Johnston and William C. Howell Griffiss AFB, N. Y. RADC Sep. 1967 66 p refs
(Contract AF 30(602)-4307)
(RADC-TR-67-411; AD-660115)

Six experiments were conducted in an effort to systematically appraise the effects of selected variables on sustained attention to a complex display. The goal was to isolate task conditions yielding poor or unstable monitoring performance, and to assess the feasibility of overcoming these detrimental effects by modifying the characteristics of the display. The investigation of task variables revealed that either a slow rate of signals or a low ratio of relevant to irrelevant signals is likely to yield inferior monitoring performance. The manipulation of display variables under these undesirable task conditions indicated that the inhibitory effect of low signal frequency can be combated by making the stimulus codes dissimilar and by using a high-quality display, and that the deleterious effect of a low ratio of relevant to irrelevant signals can be minimized by making the irrelevant stimulus codes dissimilar and, in some cases, by using a high-quality display. TAB

N68-11178*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION, PHASE A. VOLUME 1: ANALYSIS OF NEW CONCEPTS Final Report
R. B. Jagow, ed. 15 Dec. 1967 154 p refs
(Contract NAS2-3818)
(NASA-CR-73158) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Methane, methanol, glycerol, and hydrocarbons were studied as candidates for microbial life support systems for space missions exceeding one year. The need for more desirable algal and hydrogenomonas strains was investigated, as were the use of radioisotope phosphors for illumination of algae, chemical synthesis of fats and proteins, formaldehyde synthesis using chromatographic reactors, and glycerol synthesis using acetylene as an intermediate. Animal links in a man–plant–animal closed system were considered, as well as the use of biological wastes for propulsion and radiation shielding. Waste regeneration, waste incineration, and chemical synthesis of food in the closed system were considered. M.W.R.

N68-11203# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PROCESSES OF CONTROL IN LIVING ORGANISMS AND PATHS OF CREATION OF NEW CYBERNETIC SYSTEMS [ISSLEDOVANIYA PROTSESSOV UPRAVLENIYA V ZHIVYKH ORGANIZMAKH I PUTI SOZDANIYA NOVYKH KIBERNETICHESKIKH SISTEM]
M. A. Khvedelidze 5 Sep. 1967 44 p refs Transl. into ENGLISH from Tr. Kibernetiki Inst., Akad. Nauk GRuzSSR (USSR), v. 1, 1963 p 169–190
(FTD-MT-66-66; TT-67-63233; AD-660409)

A short survey is offered of work in the field of investigations of control processes in living organisms and applications of the knowledge gained to the solution of engineering problems: improvement of existing machines and systems, and creation of essentially new ones. Author (TAB)

N68-11236 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF ENGINEERING PSYCHOLOGY
P. I. Zinchenko, ed., V. P. Zinchenko, and B. F. Lomova 25 Jan. 1967 360 p refs Transl. into ENGLISH of the book "Problemy Inzhenernoy Psikhologii" Leningrad, Akad. Ped. Nauk RSFSR, 1965 p 1–223
(FTD-HT-66-220; TT-67-63239; AD-660414)

CONTENTS:

1. AN EXAMINATION OF MEMORY IN CONNECTION WITH THE TASKS OF ENGINEERING PSYCHOLOGY P. I. Zinchenko and V. P. Zinchenko p 2–27 refs (See N68-11237 02-05)

2. MEMORY CAPACITY AND AMOUNT OF INFORMATION P. B. Nevel'skiy p 28–166c refs (See N68-11238 02-05)

3. INVESTIGATION OF THE OPERATIVE MEMORY G. V. Repkina p 167–237 refs (See N68-11239 02-05)

4. SOME METHODS OF INFORMATION CODING N. I. Ryzhkova p 238–253 refs (See N68-11240 02-05)

5. THE STRUCTURE OF MNEMITIC ACTIVITY V. Ya. Lyaudis p 254–302 refs (See N68-11241 02-05)

6. GENESIS OF THE OPERATIONS OF THE MNEMITIC EFFECT L. M. Zhitnikova p 303–317 refs (See N68-11242 02-05)

7. CERTAIN CONDITIONS FOR THE RATIONAL USE OF MEMORY DURING TRAINING V. V. Repkin and G. K. Sereda p 318–326 refs (See N68-11243 02-05)

N68-11237 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN EXAMINATION OF MEMORY IN CONNECTION WITH THE TASKS OF ENGINEERING PSYCHOLOGY [ISSLEDOVANIYE PAMYATI V SVYAZI S ZADACHAMI INZHENERNOY PSIKHOLOGII]

P. I. Zinchenko and V. P. Zinchenko *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 2–27 refs (See N68-11236 02-05)

The authors discuss the role of memory processes in the activities of operators of automatic control systems. In the context of engineering psychology, matching the working characteristics of the human operator with the characteristics of automated systems is essential. Further progress in production automation and the construction of control systems will open up more and more possibilities for transferring a number of functions previously carried out by man to the machine. The first problem with respect to memory has been formulated in a study of the structure of mnemitic activity (V. Ya. Lyaudis). The results of working out this problem might be not only a necessary prerequisite for, but also a definite stimulus to further improvement of memory storage systems. Author

N68-11238 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEMORY CAPACITY AND AMOUNT OF INFORMATION [OB'YEM PAMYATI I KOLICHESTVO INFORMATSII]

P. B. Nevel'skiy *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 28–166c refs (See N68-11236 02-05)

The author discusses information and memory, the concept of memory capacity, the relation of memory capacity to the number of symbols to be remembered, and whether memory capacity depends on the amount of information. He discusses experiments with artificial concepts and deals with memory capacity in equally probable appearance of symbols from different alphabets; memory capacity, amount of information, and number of symbols; and memory capacity in the case of equally probable appearance of symbols of one alphabet. Experiments with words and a brief survey of memory capacity studies is also given. Two paths of reprocessing information in human memory are discussed. Author

N68-11239 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE OPERATIVE MEMORY [ISSLEDOVANIYA OPERATIVNOY PAMYATI]

G. V. Repkina *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 167–237 refs (See N68-11236 02-05)

The operative memory is a necessary component of any activity. The characteristics of the operative memory depend on the purposes and tasks of the activity being served. Operative memory units are formed in the process of mastering the activity. The accumulated processes of mnemitic treatment of the material, directly connected with the formation of perceptive and thought operations, lie at the basis of the formation. The latter can serve as a basis for the formation of the operative memory units only at that level of their development when they are subject to contraction and automation. New processes of operative mnemitic treatment of the material are accumulated in the process of mastering the activity. The basic path of the formation of the operative units consists of conversion of purposefully directed actions into automatic operations. Determination of the principles of the formation of the operative memory units is a condition for high quality of the learning. Author

N68-11240 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME METHODS OF INFORMATION CODING [O NEKOTORYKH SPOSOBAKH KODIROVANIYA INFORMATSII]

N. I. Ryzhkova *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 238–253 refs (See N68-11236 02-05)

According to the experimental data obtained by a number of investigators, the effectiveness of coding is determined by many factors: by the choice of the symbol alphabet, by the nature of the task being resolved by the human operator, by the degree of compatibility of the symbol alphabet and the information being coded and others. The effectiveness of coding in relation to the factors indicated has usually been studied in connection with the characteristics of perception processes. Memory in such studies was represented almost exclusively by the recognition process. However, the effect of these and other factors on the effectiveness of information coding in connection with the characteristics of the functioning of such complex memory processes as remembering and reproduction remains almost unstudied. Author

N68-11241 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STRUCTURE OF MNEMITIC ACTIVITY [O STRUKTURE MNEMICHESKOGO DEYSTVIYA]

V. Ya. Lyaudis *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 254–302 refs (See N68-11236 02-05)

This article deals with the study of the structure of mnemitic activity. An experiment was conducted to study the relationship of remembering to the structure of material being remembered. Results given in the article make it possible to believe that the composition of the mnemitic activity which has been noted gives a functional characterization of the remembering process. The resolution of a mnemitic task represents a system of actions connected with organization of the material for purposes of subsequent reproduction. The analysis which has been made confirms the idea expressed in Soviet psychology of memory. Author

N68-11242 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENESIS OF THE OPERATIONS OF THE MNEMITIC EFFECT [K VOPROSU O GENEZISE OPERATSIY MNEMICHESKOGO DEYSTVIYA]

L. M. Zhitnikova *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 303–317 refs (See N68-11236 02-05)

This article deals with an investigation directed toward a study of the process of formation of the mnemitic effect in children of preschool age during learning. The formation of the mnemitic effect in the classification process was studied. It was shown in many papers that grouping of material in various forms (semantic grouping, composition of a plan, etc.) is the most important method of remembering, and classification represents one type of grouping. Author

N68-11243 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CONDITIONS FOR THE RATIONAL USE OF MEMORY DURING TRAINING [O NEKOTORYKH USLOVIYAKH RATSIONAL'NOGO ISPOL'ZOVANIYA PAMYATI V PROTSESSE OBUCHENIYA]
V. V. Repkin and G. K. Sereda *In its* Probl. of Eng. Psychology 25 Jan. 1967 p 318–326 refs (See N68-11236 02-05)

Memory is one of the most important mental processes responsible for the mastery of skills, and therefore it plays an extremely important role during training. This article attempts to characterize some of the conditions for the organization of effective training, including operator training. Author

N68-11283* Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS EXCEEDING ONE YEAR IN DURATION, PHASE 1A. VOLUME 2: MISSION STUDIES
R. B. Jagow, ed. 15 Dec. 1967 156 p refs
(Contract NAS2-3818)
(NASA-CR-73159) CSCL 06K

New concepts for use of metabolic wastes in closed life support systems were examined for application to a model Earth orbiting space station, lunar base, and interplanetary vehicle. The processing of metabolic wastes for use as radiation shielding, propulsion propellants, extravehicular life support system expendables leakage makeup gases, and starting materials for biological or chemically synthesized food were studied. Systems using these concepts were configured and compared for each model mission. The use of wastes for radiation shielding, EVA expendables, and food leakage makeup were found to be very competitive with *Hydrogenomonas* and glycerol food synthesis systems for all missions. The use of wastes for propulsion and the baseline system using stored food and dumping wastes to space ranked low in the comparison studies. Author

N68-11289# Human Engineering Labs., Aberdeen Proving Ground, Md.
A PRELIMINARY STUDY OF SOME VARIABLES AFFECTING PULSED-TONE BEKESY THRESHOLDS
R. Bruce McCommons and David C. Hodge Aug. 1967 19 p refs
(TM-14-67; AD-659806)

The study was performed to determine the effects of varying the period and duty cycle of a pulsed tone on the sensitivity and variability of Bekesy thresholds at several test frequencies. Ten subjects were tested using 36 combinations of these variables. It was determined that threshold sensitivity improves both with longer periods and with higher duty cycles, and that lengthening the period adversely affects intratest variability. Frequency was ruled out as a significant variable. The effects of temporal auditory summation and repetition rate of the pulses as determinents of these results are discussed. Author (TAB)

N68-11337# RAND Corp., Washington, D. C.
THE CHROMATICITIES OF SUBJECTIVE COLORS ELICITED BY ROTATION OF THE FECHNER–BENHAM DISC
Guy Verriest and Ryo Seki Oct. 1967 17 p refs Transl. into ENGLISH from Rev. D'Optique Theorique et Instrumentale (Paris), v. 43, 1964 p 53–63
(P-3682; AD-660102)

The subjective colors obtained by the rotation of a Fechner-Benham pattern were matched against the Munsell book of colors. The main series of measurements was obtained under a C source providing an illumination of 1700 1x and the data have been converted into values for Y, x and y and also into values for lambda sub d and P sub e. TAB

N68-11383# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
VISUAL-VESTIBULAR INTERACTION AND THRESHOLD FOR ANGULAR ACCELERATION Final Report
John E. Marshall 10 Oct. 1967 12 p refs
(USAMRL-754; AD-660287)

Subjective response latencies from 36 Ss were used as an index of threshold across four intensities of angular acceleration (1.5, 3, 6, and 12 degrees/sec sq.) under three different visual conditions. These included total darkness (D), a simple, structured visual environment which rotated with S(LA), and a homogeneous, illuminated visual field (L). The results indicate that while illumination of the structured visual field lowers subjective threshold for angular acceleration, its differential effect is reduced with increased acceleration intensities. Visual field articulation enhances threshold sensitivity when compared with darkness, but not when L X LA comparisons are made. Author (TAB)

N68-11393# John Tracy Clinic, Los Angeles, Calif.
RESEARCH IN SENSORY THRESHOLD MEASUREMENT Final Report
Edgar L. Lowell 15 Sep. 1967 49 p refs
(Contract Nonr-3397(00))
(AD-660011)

The report describes studies of auditory threshold with a special purpose average response computer. The first section describes the development of the equipment used in early phases of the study. Three special purpose analog computers are described, and block diagrams provided. The second section summarizes a number of unpublished studies. They detail the effects of various stimulus parameters upon the shape of the evoked waveform; tone bursts produce greater amplitude than clicks; low frequency tone burst produce greater amplitude than high frequency tone bursts; increasing the intensity of the tone bursts, increases the amplitude and decreases the latency of the response. These findings illustrate the difficulty of establishing any fixed response criteria. Under optimum conditons, evoked potentials are obtainsble to within 10 or 20 dB of most subjects subjective response threshold. Instructions or tasks which increase the subjects attention to the auditory stimuli increase both amplitude and latency. A third section describes a study of a large, negative potential that is present when the auditory stimulus is given information bearing properties. This wave was described, by Grey Walter, as a Contingent Negative Variation. This study was conducted with 40 institutionalized mentally retarded patients who presumably would have had some difficulty in forming the necessary association. The Contingent Negative Variation was present in 20 Mongoloids, but absent in 20 patients with unknown etiology. Author (TAB)

N68-11398# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
SYMPOSIUM ON RELIABILITY OF HUMAN PERFORMANCE IN WORK
William B. Askren, ed. May 1967 51 p refs Ann. Conv. of the Am. Psychological Assoc. held in New York, 5 Sep. 1966
(AMRL-TR-67-88; AD-659140)

CONTENTS:

1. CLASSIFICATION OF HUMAN ERROR J. W. Altman (Am. Inst. for Res.) p 3–16 refs (See N68-11397 02-05)
2. SOME LIMITATIONS IN USING THE SIMPLE MULTIPLICATIVE MODEL IN BEHAVIOR QUANTIFICATION A. D. Swain p 17–31 refs (See N68-11398 02-05)
3. APPLICATIONS OF HUMAN RELIABILITY TO THE PRODUCTION PROCESS D. Meister (Bunker-Ramo Corp.) p 33–45 refs (See N68-11399 02-05)

N68-11397# American Inst. for Research, Pittsburgh, Pa. Inst. for Performance Technology.

CLASSIFICATION OF HUMAN ERROR

James W. Altman *In* AMRL Symp. on Reliability of Human Performance in Work May 1967 p 3–16 refs (See N68-11396 02-05)

Alternative ways of classifying human error to facilitate integration of error data for reliability estimates useful to psychologists, are examined. Performance orientation is treated with respect to 1) the coding of errors to the phases of activity (system functions, subsystem loci, tasks, or individual actions), 2) classification of errors according to some general set of process categories, 3) classification at a more general or macroscopic level, and 4) classification according to areas of skill and knowledge content. L.S.

N68-11398# Sandia Corp., Albuquerque, N. Mex. Systems Reliability Div.

SOME LIMITATIONS IN USING THE SIMPLE MULTIPLICATIVE MODEL IN BEHAVIOR QUANTIFICATION

Alan D. Swain *In* AMRL Symp. on Reliability of Human Performance in Work May 1967 p 17–31 refs Sponsored by AEC (See N68-11396 02-05)

Some practical limitations in using the simple multiplicative model with a molecular definition of behavioral elements to estimate task reliability in man–machine systems, are discussed. Advantages of estimating conditional probabilities of molar units of behavior when using the probability tree technique in reliability analysis, are described. A Monte Carlo simulation of the molecular approach using the simple multiplicative model is presented, and the use of these results in probability trees is discussed. Results indicate that a molar approach is more practical than a molecular approach. When using the simple multiplicative model, interaction effects should be taken into account. But if these effects are taken into account by estimating conditional probabilities of larger units of behavior, then these larger units can be represented by branches in a probability tree diagram and the Product Rule can be used for each success path. L.S.

N68-11423# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF DISTANCE AND POSTURE OF OBSERVER ON THE PERCEPTION OF SIZE

Chi-cheng Ching, Jui-hsueng Peng, and Yun-chiu Fang 28 Apr. 1967 31 p refs Transl. into ENGLISH of Hsin Li Hsueh Pao, no. 1, 1963 p 20–30

(FTD-HT-67-162; TT-67-63242; AD-660442)

Under normal observation conditions, the size perception constancy of the observer with regard to an object has the tendency to shrink with the increase in the viewing distance. It, however, does not shrink proportionally with the increase in the distance. Using a subjective attitude of observation, the size perception of the object is, in general, smaller than complete invariance (actual size) values. Only a few individual observers display an overestimation phenomenon regarding the perceptual size of the object. The observation postures, prone, supine or bending backward affects the size perception of the observer. It tends to shrink the perceptual size. The prone postures of the observer has more prominent effect on his size perception. Proning 90 degrees has greater effect than proning 45 degrees. In other words, when the body prones forward in making the observation, the object appears smaller and when the angle of forward proning is greater, the objects appear smaller. The effect on perceptual size is the greatest when the observation is made in a bending backward posture. The perceptual size of the object becomes markedly smaller. Author (TAB)

N68-11399# Bunker-Ramo Corp., Canoga Park, Calif.

APPLICATIONS OF HUMAN RELIABILITY TO THE PRODUCTION PROCESS

David Meister *In* AMRL Symp. on Reliability of Human Performance in Work May 1967 p 33–45 refs (See N68-11396 02-05)

The importance of production worker error to system reliability, and ways in which workmanship error and its causes may be detected and investigated, are discussed. Characteristics that differentiate production error from operating error are noted; and factors that predispose to worker error are analyzed in the context of the production process as a man–machine system. L.S.

N68-11510*# Webb Associates, Yellow Springs, Ohio.

THE PRINCIPLE OF THE SPACE ACTIVITY SUIT

Paul Webb and James F. Annis Washington NASA Dec. 1967 34 p refs

(Contract NAS1-6872)

(NASA-CR-973) CFSTI: HC $3.00/MF $0.65 CSCL 05B

This paper describes in principle a Space Activity Suit (SAS) designed for an active astronaut working in a vacuum for up to four hours. The suit will consist of a powerful elastic net leotard combined with positive pressure breathing via helmet and trunk bladders. Under the terms of the present contract, an elastic sleeve-and-glove was constructed to demonstrate the principle of the full SAS suit. Subjects wore the garment in an arm chamber which produced negative pressures up to 200 mm Hg (8 in Hg). Exposures to near-vacuum conditions were accomplished in an altitude chamber where the total pressure was 155 mm Hg and the arm chamber pressure was 5 to 8 mm Hg. The near-vacuum exposure for 20 minutes produced no evidence of gaseous swelling; arterial and venous circulation was adequate; mobility and finger dexterity were excellent; increase in arm volume from accumulation of tissue fluid was approximately 5%. The successful demonstration of principle indicates that a full SAS can be developed. As an alternative to gas-filled pressure suits, its advantages would be: improved mobility, flexibility, and dexterity at small metabolic cost; simplicity in approach; low risk to the astronaut if the netting is torn; and physiological temperature regulation without power or cooling machinery. Author

N68-11541# Applied Research Lab., Waltham, Mass.

FONT RECOGNITION Final Report

Peter A. Belmont Griffiss AFB, N. Y. RADC Oct. 1967 108 p ref

(Contract AF 30(602)-4066)

(F-6161-1; RADC-TR-67-348; AD-660125)

The need to design multifont print-readers is becoming critical as the volume of typewritten material received by various government agencies and the need to encode it for use by computers grow. The present study assumes the possibility of designing excellent single-font print-readers and studies the question of combining several of them to form one multifont print-reader. In this research, human font recognition is studied, and unaided font recognition is looked into. Several cooperative methods, in which the input document must be specially marked to facilitate font recognition, are studied, and one is studied extensively and simulated on the GE-635 computer. The latter method required the input document to display six characters–g, y, 1, 3, 4, 5–by inspection of which positive identification can be made for all of the 21 fonts studied. Author (TAB)

N68-11623# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

ELEMENTARY PHYSICAL PRINCIPLES OF TRANSPORT PERTAINING TO IONIC SYSTEMS, SEMICONDUCTORS AND ELECTROPHYSIOLOGICAL MEMBRANES

Alexander Mauro (Rockefeller Univ., N. Y.) 3 Jul. 1967 72 p refs Lextures held at Ist. Super. di Sanita, 3–14 Jul. 1967

(ISS-67/19) CFSTI: HC $3.00/MF $0.65

These lectures give the theoretical background for the understanding of the ionic transport phenomena through

electrophysiological membranes. The subject is dealt with in terms of analogy between ionic and semiconductor systems. First two different theoretical approaches to describe the equilibrium state are shown, and the way of measuring the potential differences in ionic systems is discussed. The non-equilibrium state is treated by the Nernst–Planck equation for the ionic transport, and the formalism of equivalent circuits for ionic systems is introduced. Finally, the philosophy of the classical experiments on squid giant axons is illustrated. The course can be easily followed by students having some acquaintance with mathematics and physics, especially with classical thermodynamics and electricity. Author

N68-11857# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE EFFECT OF LUNAR GRAVITY ON MAN'S PERFORMANCE OF BASIC MAINTENANCE TASKS
Richard J. Shavelson and Joseph L. Seminara 1 Jun. 1967 50 p refs
(LMSC-6-77-96-0; AD-660457)

Nine subjects were trained extensively on three maintenance tasks: bolt torquing, connector mating, and nut threading. They were randomly distributed into one of three clothing conditions (shirt-sleeve, vented suit, and pressurized suit) and trained and tested on all three tasks in three gravity conditions (one gravity, one gravity in the harness, and one-sixth gravity). This study demonstrated that lunar gravity imposed a twenty-five-percent performance decrement over performance in one gravity ($P<.01$). The vented suit imposed a sixty-percent performance decrement ($P<.01$) and the pressurized suit imposed a 150-percent performance decrement ($P<.01$) when compared to performance in the shirt sleeve mode. On the basis of these findings and subjective reports, preliminary human factors design criteria were suggested for lunar gravity performance aids. The need for subsequent research in the areas of mission-specific maintenance tasks and candidate job aids to improve performance in the lunar environment was pointed out. Author (TAB)

N68-11858# Rutgers Univ., New Brunswick, N. J. Douglass Coll.
IMPRESSION FORMATION AS A MEASURE OF THE COMPLEXITY OF CONCEPTUAL STRUCTURE
Siegfried Streufert and Michael J. Driver (Purdue Univ.) Sep. 1967 25 p refs
(Contract N00014-67-A-0115-0002)
(TR-5; AD-659962)

An alternate is presented to the sentence completion test, which was specifically designed to measure one kind of complexity only: perceptual social complexity. This measure is called the Impression Formation Test. In its original form it was first proposed by Streufert and Schroder (1963), but has since undergone considerable alteration in both administration and analysis. Author (TAB)

N68-11828* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ACCELERATION TERMINOLOGY TABLE OF COMPARATIVE EQUIVALENTS
Gerard J. Pasman Sep. 1965 10 p refs Presented at the Biodyn. Comm. of the Aerospace Med. Panel, Munich, 1–7 Sep. 1965
(NASA-TM-X-60710) CFSTI: $3.00 CSCL 05E

Revisions to two tables of equivalents for acceleration terminology are presented. The tables depict linear and angular motion for human and vehicle coordinate systems. Conventional vehicle axes and axes for space vehicles or VTOL aircraft are included. The interrelationships between vehicle acceleration, the consequent force acting on an occupant, and equivalent terms used to describe directions of these variables are shown in the tables. E.C.

N68-11855*# System Development Corp., Dayton, Ohio.
IMPLEMENTATION OF COMPUTER SOFTWARE TECHNIQUES TO HUMAN FACTORS TASK DATA HANDLING PROBLEMS Final Report, 21 Jun.–30 Jun. 1967
A. T. Tulley and G. R. Meyer Sep. 1967 98 p refs
(NASA Order R-115; Contract F33615-67-C-1036)
(NASA-CR-90525; AMRL-TR-67-127) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Research leading to the implementation of computer software techniques for handling human factors task data generated in support of aerospace system development programs is discussed. Techniques being explored are based on the assumption that a user-oriented computerized data system will help draw human factors specialists closer to needed data, reduce the problem of data accessibility, and allow more effective use of data in the system engineering process. Proposed data handling techniques are discussed. A computerized data handling system to store, retrieve, and process human factors task data is initially implemented through a pilot study, and design specifications for a computerized experimental system are presented. This system provides the primary means for demonstrating and evaluating the research results against the original research goals. Computer software descriptions are also presented for implementing the pilot study experimental system in a user-oriented environment in terms of information needs of human factors specialists. Author

N68-11871*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Biotechnology Organization.
STUDY AND PRELIMINARY DESIGN OF AN ISOTOPE-HEATED CATALYTIC OXIDIZER SYSTEM, ADDENDUM I
Richard A. Lamparter [1967] 57 p refs
(Contract NAS1-6256)
(NASA-CR-66497) CFSTI: HC $3.00/MF $0.65 CSCL 06K

A study was performed to develop data on system including pre and postsorbent beds for 3, 6 and 9-man crew sizes. This work has been used to support a Basic Subsystem Module (BSM) Study. The basic study assumed the inlet gas stream to be free of compounds which might poison the catalyst. The contaminant load was evaluated to define potential catalyst poisons and compounds which might yield toxic products of combustion and sorbents were evaluated which might be used to remove these compounds. Activated charcoal and lithium hydroxide were found to comprise the optimum presorbent bed and lithium hydroxide, the optimum postsorbent bed. The BSM Study considered the use of isotope and electric heat sources for life support systems. Evaluation of the design shows that its configuration is near optimum for an electrically heated version with the exception of the provisions made for intact reentry. The 9-man pre and postsorbent bed and catalytic oxidizer designs were combined into an integrated system. The favored installation for the system is downstream of the main activated charcoal bed in the BSM life support system, primarily to utilize this charcoal as a pre-sorber. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-11026# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. DETERMINATION OF TOTAL OXYGEN IN Al–Al_2O_3 ALLOYS BY FAST NEUTRON ACTIVATION ANALYSIS

Edward T. Bramlitt 15 Aug. 1967 27 p refs Prepared jointly with Combustion Engineering, Inc.
(Contract AT(38-1)-430)
(AI-CE-74) CFSTI: HC$3.00/MF$0.65

A method for the determination of the oxygen content of Al–Al_2O_3 alloys, using fast neutron activation analysis, is described. Equipment with automatic control and techniques for improving the precision of measurements are specified. Over the range of 100 to 3000 mg oxygen, a precision of 1 to 3% (relative) is attainable, using dual sample irradiation with dual axis rotation during irradiation. The use of Lucite as an oxygen standard provides a stable, easily prepared reference material for the comparator technique used in activation analysis. Samples can be prepared, analyzed, and the data reported in much less than one hour per sample. Author (NSA)

N68-11032# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. MELTING POINTS, TRANSITION ENERGIES, AND SPECIFIC HEATS OF POLYPHENYL REACTOR COOLANTS
H. Mandel 15 Aug. 1967 25 p refs Prepared jointly with Combustion Engineering, Inc.
(Contract AT(38-1)-430)
(AI-CE-58) CFSTI: HC$3.00/MF$0.65

Differential scanning calorimetry, a relatively new quantitative technique for making direct calorimetric measurements, was applied to studies of the melting behavior, transition energies, and specific heat of polyphenyls. The apparatus was used to determine melting points and heats of fusion of the major constituents of polyphenyl coolants, namely, biphenyl and ortho-, meta-, and para-terphenyl. The melting characteristics of two synthetic terphenyl binaries similar to proposed HWOCR coolants (orthometa isomer ratios of 2:1 and 1:2) were studied with respect to the effect of the high boiler (HB) fraction of the radiolytic and pyrolytic decomposition products and of para-terphenyl on the melting transition range. The effect of HB addition on the two binary mixtures is both time and concentration dependent in that the observed crystallinity of the samples decreases with increased HB addition, and increases with time. The addition of paraterphenyl to both binary mixtures, with and without HB, increases their final melting point. The calorimetric capabilities of the instrument were also utilized in measurement of the specific heats of solid biphenyl, ortho-, and para-terphenyl. Author (NSA)

N68-11041# Lincoln Lab., Mass. Inst. of Tech., Lexington.
BIASED VELOCITY ESTIMATES DUE TO PHASE-CENTER MOTION
Sidney L. Borison 27 Sep. 1967 16 p refs /ts Tech. Note 1967-35
(Contract AF 19(628)-5167; ARPA Order 498; Proj. Defender)
(ESD-TR-67-507; AD-659817)

The errors induced by scattering-phase variations on estimates of radial velocity and acceleration from radar signals are discussed. For small changes in target orientation during the measurement, the scattering phase introduces bias in the estimates. Using scattering-phase data for a cylinder, the velocity bias one might observe is indicated. TAB

N68-11049# Naval Research Lab., Washington, D. C.
INFRARED SPECTRA OF SURFACE FILMS OF POLY-γ-METHYL-L-GLUTAMATE
George Loeb and Robert E. Baier 20 Jul. 1967 16 p refs
(NRL-6554; AD-659947)

Surface pressure vs area isotherms of poly-gamma-methyl-L-glutamate spread on water from solutions of chloroform differed from those obtained when the polymer was spread from solutions of high pyridine concentration. Samples for studying infrared spectra of the material forming the monolayer were obtained by collapsing the monolayer onto a transparent plate or by depositing a monolayer by the Blodgett technique onto a multiple internal reflection prism. When solutions of the polypeptide were spread from chloroform upon water in a Langmuir-Adam film balance to form an insoluble monolayer, a plateau in the force-area isotherm and a large limiting area were observed. Spectra of these monolayers were characterized by amide I and II regions characteristic of the alpha-helical or random configuration. There was not a change in secondary structure corresponding to the plateau region detectable via the IR spectra. Spreading solutions of high pyridine concentration led to isotherms without a plateau and with a much smaller limiting area. Spectra of these monolayers showed a significant amount of beta-type material. This is the first unambiguous correlation between the infrared spectra of uncollapsed monolayers of polypeptides and their behavior at the air/water interface. Author (TAB)

N68-11052# Bureau of Mines, Salt Lake City, Utah.
CALCIUM VANADATE PRECIPITATION AND PROCESSING
C. J. Chindgren, L. C. Bauerle, and B. K. Shibler Dec. 1967 23 p refs
(BM-RI-7058)

The technical problems involved in recovering commercial-grade vanadium products from alkaline solutions of low vanadium content were investigated. Conditions were defined for precipitating calcium vanadates from sodium vanadate solutions with calcium chloride and calcium hydroxide and for dissolving the precipitates with acid, sodium carbonate, and sodium bicarbonate to obtain vanadium-enriched solutions from which either red cake or ammonium metavanadate was recovered. Calcium vanadates with $CaO:V_2O_5$ mole ratios of 2, 3, and 4 were produced with recoveries of 93 to 100 percent. Optimum recovery of the low-lime variety of calcium vanadate was obtained by employing excess calcium chloride and adjusting the pH to a range of 8.0 to 8.5. High vanadium extractions were obtained in concentrated solutions by dissolving the calcium vanadate precipitates with any of the reagents tested. The resulting extracts contained 25 to 125 grams V_2O_5 per liter. Conventional procedures used to precipitate either red cake or ammonium metavanadate from the enrichad solutions gave excellent vanadium recoveries. Author

N68-11085# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ENHANCEMENT OF THE CONDUCTIVITY MODULATION EFFECT IN SALT SOLUTIONS
C. H. Bonham, III and W. K. Rivers, Jr. 15 Aug. 1967 34 p refs
(Contract Nonr-991(08))
(TR-4; AD-660032)

The fractional change of conductivity of various inorganic and organic solutes added to aqueous sodium chloride solutions has been measured. Of the seven groups measured only the strong inorganic acids and bases and the weak organic acids and bases showed any enhancement; their addition produced a fractional change of conductivity, sigma, that was 1.4 dB greater than that for the plain sodium chloride solution. In the other groups there was no change of delta-sigma/sigma from that of salt water. All groups with the exception of weak organic acids and bases had a change in modulation index per unit pressure consistent with the measured conductivity and the theory of interaction. The value of the modulation index per unit pressure for weak organic acids and bases was 2.3 dB greater than that predicted. The measurements were made by reflecting electromagnetic and acoustic waves from the salt water surface in a coaxial test cell at a radio frequency of 147 MHz and an acoustic frequency of 17.6 KHz. The equipment used is capable of measuring an amplitude modulation index lower than 150 dB below 100 per cent for 1 Hz bandwidth. Author (TAB)

N68-11119# Naval Research Lab., Washington, D. C.
HALOGENATED HYDROCARBONS. PART 2: DECOMPOSITION OF SELECTED CHLORINATED HYDROCARBONS OVER HOPCALITE CATALYST Interim Report
J. Enoch Johnson and Richard H. Gammon 20 Jul. 1967 20 p refs
(NRL-6582; AD-659956)

A study was made of the decomposition of several chlorocarbons in air when exposed to Hopcalite catalyst in a laboratory reactor from 50 to 350 C. The chlorocarbons studied were methyl chloroform, vinylidene chloride, trichloroethylene and tetrachloroethylene. At 300 C the percentage decomposition ranged from 70% for tetrachloroethylene to 100% for methyl chloroform. All yielded substantial amounts of hydrochloric acid as they decomposed. Yields of organic compounds during the decomposition of the chlorocarbons were quite small, except in the case of methyl chloroform, which yielded as much as 50% of vinylidene chloride. Author (TAB)

N68-11120# Naval Research Lab., Washington, D. C.
EFFECT OF THE CATION ON SOLUBILIZATION BY OIL-SOLUBLE SULFONATES AND THE APPLICABILITY OF THE MASS LAW Interim Report
Samuel Kaufman 5 Sep. 1967 13 p refs
(NRL-6579; AD-659955)

The dinonylnaphthalene sulfonates of cesium, sodium, barium, magnesium, and zinc were studied as solubilizing agents for methanol, normal propylamine, and acetic acid in toluene. By a previously developed gas chromatographic technique, the extent of solubilization of the three species by each of the sulfonates was measured over the range of 0 to approximately 2-wt-% solubilizate. The mass law was shown to be consistent with the experimental observation that the concentration ratio of bound solubilizate to total solubilizer is dependent upon the free solubilizate concentration and independent of the solubilizer concentration. The data and theoretical considerations lead to the additional conclusions that the partition law is not universally applicable to solubilization, and that the size distribution of micelles is fixed by the free solubilizate concentration. The initial rate of interaction as a function of free solubilizate concentration usually increased with increasing electronegativity of the soap cation. The soaps of zinc and magnesium were exceptions when acetic acid was the solubilizate. This deviation is attributed to the covalent properties of these metals and the bifunctional reactivity of acetic acid. Author (TAB)

N68-11125# Naval Research Lab., Washington, D. C.
ANISOTROPY IN PHYSICAL ADSORPTION ON GRAPHITE
Edwin F. Meyer 31 Jul. 1967 65 p refs
(NRL-6547; AD-660378)

Anisptropy of polarizability has been taken into account in calculating the relative strengths of adsorption of Ne, A, Kr, Xe, and CO2 on several possible sites in the graphite lattice. A 6-12 potential, modified to include an angular dependence arising from anisotropy considerations, was summed over the lattice. As a direct result of the anisotropy, sites on the plane consisting of edges of basal planes exhibit a higher energy of adsorption at 0 K for all the gases considered. Calculations ignoring anisotropy have shown that the nature of the results depends markedly on this characteristic of graphite. For the inert gases at -196 C, adsorption is still favored on the edge plane unless the adsorption is considered to be immobile. In contrast, for CO2 at 0 C entropy effect predominates and the basal plane offers the more favorable sites for adsorption. These calculations have ignored any unusual edge effects which may overwhelm the anisotropy effects; in the absence of such effects anisotropy is able to account for the existence of two types of sites on graphite, the relative stability of which depends on temperature. Author (TAB)

N68-11132# Systems Research Labs., Inc., Dayton, Ohio.
RELATIONS BETWEEN POINT DEFECTS IN THE COMPOUND MX
Norman M. Tallan (ARL), Henry C. Graham (ARL), Robert W. Vest, and Walter C. Tripp Wright-Patterson AFB, Ohio ARL Jul. 1967 140 p Prepared Jointly with ARL
(Contract AF 33(657)-10815)
(ARL 67-0147; AD-659752)

The results of a computer study of the mass action equations as used for the formation of point defects in binary compounds are presented. The results are in easily read tabular form from which a neutrality condition can be deduced for a particular predominant defect. The pressure dependence and the equilibrium constants involved in the formation of each defect are listed. Author (TAB)

N68-11136 United Kingdom Atomic Energy Authority, Windscale (England). Reactor Development Lab.
EXPERIENCE IN TESTING INSTALLED FISSION PRODUCT TRAPPING PLANT WITH METHYL IODIDE
J. J. Hillary, L. F. Gate, and K. Gurney 1967 14 p refs
(TRG-1548(W)) HMSO: 2s 6d

A simple experimental procedure has been developed, based on labelled methyl iodide, for the full-scale in-site testing of the charcoal bed of an installed fission product trapping plant. A decontamination factor of 1000 is easily measurable for a 10,000 ft^3/min. plant with a few mc Iodine-131. Tests carried out to date on several plants indicate the need for such tests since the results have in some cases shown inadequate performance, which has usually been associated with mechanical leakage. The most effective method of achieving reliable sealing appears to be to pass gas downwards through a bed of charcoal which completely fills the available area, rather than to attempt to seal an assembly holding a bed into a flange in the duct or vessel. Provision should be made for withdrawing representative samples of charcoal for laboratory testing. Author

N68-11189# Naval Radiological Defense Lab., San Francisco, Calif.
HIGH TEMPERATURE MEASUREMENTS OF THE RATE OF UPTAKE OF MoO_3 VAPOR BY SELECTED OXIDES
Charles E. Adams, William R. Balkwell, and Jack T. Quan 13 Jun. 1967 52 p refs
(USNRDL-TR-67-98; AD-660173)

As part of a program for elucidation of the process of formation of radioactive fallout, a method was developed for measuring the condensation rates of vaporized MoO3 onto liquid and solid oxide substrates in air at high temperatures. Rate measurements were made from 800 to 1500C and over a MoO3 partial pressure range of about 0.0000001 to 0.00004 atm. Substrates of a fused clay loam and a calcium ferrite were used in most of the measurements. Information was obtained concerning the rate-controlling steps in the condensation process. Author (TAB)

N68-11196# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
ALKYL AND ARYLALUMINUM COMPLEXES. 2: POLYMERIZATIONS OF DIETHYLALUMINUM-2-AMINOETHOXIDE AND DIETHYLALUMINUM-3-AMINOPROPOXIDE
James A. Scruggs, Thomas J. Hurley, Martin A. Robinson, and Samuel I. Trotz 18 Oct. 1967 10 p ref Submitted for publication
(Contract Nonr-5039(00))
(TR-4; AD-660400)

The dialkylaluminum-2-aminoethoxide and -3-aminopropoxide complexes reported in AD-642 608 were polymerized to the corresponding polyiminoalanes. Structural aspects are discussed and analytical data presented. Author (TAB)

N68-11205# Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
REACTIONS OF FREE RADICALS Final Report, 1 Oct. 1963–31 Oct. 1967
William A. Pryor 31 Oct. 1967 14 p refs
(Grant AF-AFOSR-540-66)
(AFOSR-67-2386; AD-659765)

A summary is given of work in the following areas: (1) free radical polymerication of styrene (see AD-635 359) and pentafluoro styrene; (2) use of hydrogen sulfide as a radical scavenger in the gamma radiolysis of organic materials; (3) gas chromatographic study of reactions of methyl radicals; (4) mechanism of oxygen-18 exchange between thiosulfate and water (see AD-659 566). TAB

N68-11213# McMaster Univ., Hamilton (Ontario).
A STUDY OF LITHIUM FLUORIDE ETCH MORPHOLOGIES USING SILICA GEL
Michael B. Ives and Roderick O. McElroy Sep. 1967 57 p refs
(Contract Nonr-3925(00))
(TR-10; AD-660381)

Cleavage surfaces of lithium fluoride were etched on a silica hydrogel containing ferric ions as inhibitor. The dissolution etch pits and features were examined by interference and electron microscopy. The ledge structure of pits thus formed is very regular. It is proposed that the gel eliminates turbulence in the system and retards the diffusion of ferric ions towards the dissolving interface. An explanation for the observed rounding of pits at very high inhibitor concentration is proposed. Author (TAB)

N68-11219# Army Engineer Research and Development Labs., Fort Belvoir, Va.
POLAROGRAPHIC DETERMINATION OF COPPER IN PAPER
Dario A. Emeric Sep. 1967 11 p refs
(AERDL-1910; AD-659768)

A polarographic method was developed for the determination of copper present as copper-8-quinolinolate and copper-8-derivatives in paper sandbags. The polarographic method uses 1:1 orthophosphoric acid as the supporting electrolyte and lead as the pilot ion. Paper sandbags containing 0.14% copper as copper-8-quinolinolate were used for this work. It is concluded that this polarographic method can be used for the determination of copper in paper. It is superior to the presently used electrolytic method with respect to time (5 hours versus 1 hour). The results obtained by polarography are in agreement with those obtained by the electrolytic method. Author (TAB)

N68-11228# Ottawa Univ. (Ontario).
ELECTROCHEMICAL STUDIES OF PLATINUM SURFACE OXIDATION IN RELATION TO HYDROCARBON OXIDATION. PART 5: STUDIES WITH C_2H_4 AND FORMATE AT Pt AND Pd Interm Report, Oct. 1966–Jul. 1967
J. Wojtowicz and L. Marincic Jul. 1967 144 p refs
(Contract CP-70-A1-63-4)
(AD-660428)

Topics include: Studies in the role of surface oxide in ethylene oxidation at platinized platinum and the question of reaction orders; examination of the oscillatory effects which are observed in C2H4 oxidation and extensions of these observations to a model system involving formate oxidation where oscillatory behaviour is more controllable and can be studied with greater facility; studies on electrode rotation effects in relation to the role of mass transport in ethylene oxidation and in the model reaction of formate oxidation at Pt and Pd; conclusion of C14 studies (see AD-660 428) by use of acetate labelled at the C1 and C2 positions in relation to adsorption of (a) carboxylate anions, (b) adsorption of CO2 and (c) adsorption of hydrocarbon radical species, viz. the CH3 group in this case; studies on current distribution and metal-solution potential profile at electrodes of significant ohmic resistance in relation to problems of current distribution in high load electrode configurations such as may arise in batteries and fuel cells; high temperature studies on the surface oxidation of Pt electrodes in aq. medium up to 300C at elevated pressures. TAB

N68-11244# Oregon Univ., Eugene.
THE SHIFT OF SOME OF THE EMISSION LINES OF IRON AND OTHER METALS (CR, NI, CA, CU AND AL) PRODUCED BY ARGON AND HELIUM
Quentin A. Holmes and Shang-Yi Ch'en 1 Oct. 1967 156 p refs
(Grant AF-AFOSR-1220-67)
(AFOSR-67-2286; AD-659420)

The report furnishes the observation and analysis of the pressure shift of 130 emission lines of metal atoms (in the region 2947–5900Å) produced by various relative densities of argon and helium by means of a ballistic compressor. Eighty of these lines belonged to FeI; the remainder were due to CrI, CuI, MnI, NiI, NaI, CaI and CaII. The temperatures of compressed gases were 3230°K (R.D. varied from 28–104) for argon, and 3600°K (R.D. ranged from 36–108) for helium. Observations were also made on the shift of metal lines at various temperatures under a constant R.D. of argon. A comparison of the relative displacement of iron levels which differed in only one of the following: their J-value, L-value, multiplicity, or electron configuration suggested four general statements. Author (TAB)

N68-11281# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. THE PREPARATION OF URANIUM CARBIDE FROM ECONOMICAL URANIUM COMPOUNDS
L. A. Hanson 15 Aug. 1967 34 p refs Prepared jointly with Combustion Engineering, Inc.
(Contract AT(38-1)-430)
(AI-CE-73) CFSTI: HC $3.00/MF $0.65

The preparation of uranium carbide (UC) from uranium tetrafluoride, ammonium diuranate (ADU), and uranium trioxide (UO_3) was studied on a gram scale to establish basic process parameters for economic comparison with the conventional UO_2 to UC fabrication method. The process developed in each case involved compacting blended powders (which were, respectively, UF_4–SiO_2–C, $(NH_4)_2U_2O_7$–SiO_2–C, and UO_3–C) and heating in vacuum in stages to convert the uranium compound to UO_2 at temperatures up to 850°C and carbothermically reduce the resulting UO_2 to UC at temperatures above 1300°C. The SiO_2 was used in the ADU conversion to remove a fluorine contaminant without uranium loss. Uranium carbide of controlled carbon content and low oxygen content was produced from each of these compounds. Uranium carbide was prepared from ADU in 20-kg quantities to demonstrate production scale-up of one of the processes studied. The UC produced was of equivalent or better quality than that produced from UO_2 under similar conditions. An economic comparison indicated that there are potential savings in using each of these materials, depending on the uranium source, instead of UO_2 for UC production. Quantitative evaluation of experimental results and overall economics indicates that only marginal savings may be gained by using ADU and UO_3; but a cost reduction is expected using UF_4. Author (NSA)

N68-11288*# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS Quarterly Progress Report, 17 Jul.–16 Oct. 1967
E. R. Blosser 2 Nov. 1967 24 p Prepared for JPL
(Contracts NAS7-100; JPL-951578)
(NASA-CR-90332; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07B

The determination of hydroxyl in solid magnesium oxide was studied by chemical decomposition and mission and mass

spectrographic techniques. Other detectable elements were also determined with the mass spectrograph, and these data are compared with available independent results. Author

N68-11310* South Carolina Univ., Columbia.
INFRARED SPECTRA OF MOLECULES AND MATERIALS OF ASTROPHYSICAL INTEREST Semiannual Progress Report, 1 Dec. 1966–30 May 1967
James R. Durig Jun. 1967 50 p refs
(Grant NGR-41-002-003)
(NASA-CR-90217; SAPR-4) CSCL 07C

A continuing study of the vibrational spectra of molecules which could be possible constituents of the Jovian atmospheres is described in the form of three appendices. The studies are concerned with the infrared spectra of HNCS and DNCS; far infrared spectra and space group of crystalline hydrazine and hydrazine-d_4; and the potential field and force constants, amplitudes of thermal motion, and bond and molecular polarizabilities of butatriene. C.T.C.

N68-11313# Hebrew Univ., Jerusalem (Israel). Dept. of Organic Chemistry.
SYNTHESIS OF ALPHA-HYDROXY-ALPHA-AMINO ACIDS AND ERGOT ALKALOIDS Final Technical Report, Jul. 1965–May 1967
Y. Liwschitz Jun. 1967 44 p refs
(Contract DA-91-591-EUC-3799)
(E-994; AD-660447)

Several different approaches for the synthesis of the peptidic side-chain of ergotamine, based on the direct use of a suitable protected alpha-hydroxyalanine, did not yield the intended results. The ethyl (I) or t-butyl ester of n-benzyloxycarbonyl-o-benzyl-alpha-hydroxyalanine when exposed to alkaline or acidic hydrolysis, respectively, under a variety of conditions, disintegrated into benzylcarbamate and pyruvic acid among other products. Enzymatic hydrolysis was also unsuccessful. Direct condensation of I with t-butyl glycinate or l-phenylalanyl-l-proline-lactam in the presence of imidazole and other catalysts could not be realized. The n-carboxyanhydride of o-benzyl-alpha-hydroxyalanine was prepared from ethyl, hydrogen o-benzyl-dl-methyltartronate, via the hydrazide and the azide which finally underwent the Curtius rearrangement. Several reactions carried out with this NCA in order to obtain suitable derivatives of alpha-hydroxyalanine did not take the expected course and under certain conditions this substance trimerized to yield dehydroalanyl-alpha-hydroxyalanyl-dehydroalanine. The n-t-butyloxycarbonyl derivatives of ethyl o-benzyl-alpha-hydroxyalaninate was synthesized, assuming it to be more stable toward alkaline hydrolysis than the benzyloxycarbonyl compound. The substance obtained analyzed correctly, but its NMR spectrum did not match the expected structure. Mass spectrography, however, showed it to possess a t-butyl group. Author (TAB)

N68-11347# Naval Radiological Defense Lab., San Francisco, Calif.
REGRESSION PARAMETERS FOR PAIRS OF EQUALLY UNCERTAIN VARIABLES
Edward C. Freiling and Glenn R. Crocker 11 Jul. 1967 26 p refs
(Contract AT(49-7)-1963)
(USNRDL-TR-67-99; AD-659977)

The correlation of radiochemical data from samples of fractionated nuclear debris involves the treatment of two variables whose uncertainties are comparable. We considered three new criteria for the establishment of regression parameters for such correlations (least square perpendicular distances between points and the line, bisection of the angle formed by the certain-X and certain-Y regression lines, and adoption of the geometric mean of the certain-X and certain-Y regression slopes). We concluded that the geometric-mean slope B prime was most satisfactory. It is related to the usual certain-X regression slope B subscript X,X and the coefficient of correlation R by the simple expression B prime = B subscript X,X/the absolute value of R. TAB

N68-11362# Massachusetts Univ., Amherst. Dept. of Chemistry.
RATES OF EXCHANGE OF SOLVENT MOLECULES WITH PARAMAGNETIC IONS Final Scientific Report
Thomas R. Stengle and Cooper H. Langford 1 Oct. 1967 24 p refs
(Grant AF-AFOSR-212-65)
(AFOSR-67-2387; AD-660139)

A summary is given of a program aimed at the elucidation of the factors which determine the rate of solvent exchange (and ligand substitution) reactions with transition metal ions in solution. In many octahedral complexes it has become apparent that the reaction is mainly dissociative in nature, and that it is relatively independent of the entering group. Hence the composition of the secbnd coordination sphere (solvation shell) plays an important role in the reaction rate. It was necessary to work out techniques for the determination of the composition of the solvation shell of a complex ion. Several methods of accomplishing this were developed; all of them depending on nuclear magnetic resonance measurements. Then exchange rates with metal ions and dimethylformamide were studied in depth. Some other systems were examined in less detail. There has resulted from the work a useful technique for the study of the kinetics and mechanisms of solvolysis reactions. Author (TAB)

N68-11390# Space-General Corp., Los Angeles, Calif. Center for Research and Education.
THE PREPARATION OF PENTABORANE-11 IN BENCH SCALE QUANTITIES
J. F. Ditter, I. W. Searcy, and R. E. Williams Oct. 1967 15 p refs
(Contract Nonr-4381(00))
(TR-14; AD-660369)

The production of pentaborane-11 was successfully scaled up to the point where about 0.75 cc per minute can be produced in runs lasting 10–20 minutes. It is made by allowing diborane at 25 psig to flow at 8 liters per minute through a 16-liter reactor maintained at 120°C. Based on diborane consumed, yields are nearly quantitative. Author (TAB)

N68-11416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXCITED PARTICLES AND THEIR ROLE IN ELEMENTARY PROCESSES OF RADIATION CHEMISTRY AND PLASMA CHEMISTRY
N. N. Tunitskiy and S. Ye. Kupriyanov 18 Aug. 1967 18 p refs Transl. into ENGLISH of the Publ. "Vozbuzhdennyye Chastitsy i Ikh Rol' v Elementarnykh Protsessakh Radiatsionnoy Khimii i Khimii Plazmy" Moscow, Nauchno-issled. Fiz-Khim. Inst., 1965 p 1–10 Presented at the Intern. Symp. on the Characteristics and Properties of Low Temp. Plasmas at the 20th Intern. Congr. on Theoret. and Appl. Chem.
(FTD-MT-65-541; TT-67-63232; AD-660408)

The value of the excitation energy of some ions at the moment of the impact were measured by means of the determination of the impulse transferred to the atom or molecule. In order to determine the excitation energy of particles to the time 0.000001 sec after the ionization the method of the second impact was used. The atoms and ions of noble gases, hydrogen molecules, oxygen molecules and others in long-lived highly excited states were detected by means of this method. These excited particles are in the states closed to the states of their following ionization. The reactions of excited and unexcited atoms and molecules are studied. It is shown, that some products (H3(+), HeH(+)) formerly treated as resulting exclusively from ion-molecules reactions areeformed also in the reactions between the neutral particles. The influence of vibrational excitation on ion-molecule reactions of the formation H3(+) was investigated. Author (TAB)

N68-11426# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.
METALLO SEMI-INORGANIC POLYMERS. Final Technical Report, 1 Sep. 1965–31 Oct. 1967
James J. Pitts and Thomas J. Hurley, Jr. 31 Oct. 1967 48 p refs
(Contract Nonr-5039(00))
(AD-660367)

The synthesis, characterization, and attempted polymerizations are described, for a variety of bidentate, tridentate, and quadridentate complexes of aluminum. An auxiliary study comparing structure and properties of the aluminum, cadmium, and nickel complexes of various phosphinates is also described. Author (TAB)

N68-11460 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CHEMICAL STABILITY OF ALUMINUM IN THE COMPOSITION OF INDUSTRIAL EXPLOSIVES [O KHIMICHESKOY STABIL'NOSTI ALYUMINIYA V SOSTAVE PROMYSHLENNYKH VZRYVCHATYKH VESHCHESTV]
B. Ya. Svetlov and R. N. Solntseva *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 21–37 refs (See N68-11458 02-33)

Extensive experiments on the interaction of Al dusts and powders with water in the presence of acid, alkali, nitrates, carboxymethylcellulose and/or potassium chromate, carried out in order to determine the usability of Al in the manufacture of explosives, showed that aqueous suspensions of Al dust are chemically unstable and that all types of Al dust react with water more vigorously than the coarser granulated powders. The Al could be rendered passive, however, by the addition of nitric acid or solutions of calcium or ammonium nitrate. Under these conditions, the evolution of H_2 is markedly reduced since some of it is used to convert nitrate groups to ammonia. Addition of the sodium salt of carboxymethylcellulose to suspensions of Al in water accelerated the reaction due to greater alkalinity. The pH could again be neutralized, however, by saturation with calcium or ammonium nitrate, after which the presence of carboxymethylcellulose was immaterial. Author

N68-11463 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SENSITIZATION OF HIGH-SAFETY AMMONIUM NITRATE EXPLOSIVES OF LIQUID NITROESTERS [SENSIBILIZATSIYA PREDOKHRANITEL'NYKH AMMIACHNOSELITRENNYKH VV ZHIDKIMI NITROEFIRAMI]
N. S. Bakharevich *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 72–75 (See N68-11458 02-33)

The sensitizing effect of liquid organic nitrates (60% nitroglycerine and 40% dinitrodiethyleneglycol) and the stabilizing effect of wood flour on ammonite PZhV-20 (64% ammonium nitrate, 16% trinitrotoluene, 20% potassium chloride), were studied. The results presented in a table show that the addition of 3–5% organic nitrates significantly increases the detonation sensitivity, but that higher percentages are not recommended since they increase the sensitivity to mechanical shock and decrease the water resistance. Addition of 1–5% wood flour (to prevent caking) to samples sensitized with 5% organic nitrates did not significantly decrease the explosive power detonation at a distance being optimal with 1–2% wood flour, although the trinitrotoluene content was decreased as the wood flour was added to maintain an oxygen balance near zero. However, addition of wood flour decreases the water resistance, so that addition of a second hydrophobic agent (e.g. stearate) or mild gelatinization with colloidal cotton is recommended. Author

N68-11464 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLASH-HIDING PROPERTIES OF AQUEOUS JELLIES [PLAMEGASYASHCHIYE SVOYSTVA VODNYKH STUDNEY]
N. S. Bakharevich and V. S. Vasil'yeva *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 76–80 ref (See N68-11458 02-33)

The suitability of using water-based jellies in blasting explosives was studied. The flame-extinguishing properties of aqueous jellies based on saturated solutions of LiCl, NaCl, KCl, ammonium chloride and calcium nitrate were investigated. Varying amounts of the water-based jellies containing 7–10% Na-carboxymethylcellulose were mixed with ammonite #6, and the combustion of the methane/air mixture was observed after explosion by various techniques. The results demonstrate that the flame-extinguishing ability of water-based jellies is significantly greater than that of the crystalline salts, due probably to the more uniform distribution in the explosive and the combined effect of water and salt. The safety of the explosives can thus be increased markedly, since the gas ignited in 70% of the cases when ammonite PZhV-20, containing 20% NaCl or KCl, was exploded under the same conditions (detonation of 100 g in the open). Additional work was done with explosives containing 10% water-based NaCl jelly. Author

N68-11512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILIZATION OF DC ARCS IN STATIC ARGON ATMOSPHERES FOR USE IN SPECTROCHEMICAL ANALYSIS
William A. Gordon Washington Dec. 1967 26 p refs
(NASA-TN-D-4236) CFSTI: HC$3.00/MF$0.65 CSCL 07D

The use of metal cathodes in an argon atmosphere was investigated and found to be highly effective in achieving a positionally stable arc column. Visual and spectral evaluations of refractory metal cathodes, including graphite, thoriated tungsten, rhenium, tantalum, molybdenum, niobium, and platinum, were made to ascertain the most suitable cathode material for this application. From these studies a combination tantalum-graphite cathode was developed. This special cathode produced arcs characterized by a diffuse cathode emission, which resulted in a stable arc column. A simple model of the arc column, based on the mechanisms of cathodic gas streaming and thermionic emission, was used to explain experimental observations relevant to stability of arcs in argon. The emission spectrum of stabilized arcs was evaluated for use in spectrochemical analysis. It was found that, under the specified conditions, the excitation characteristics of the stabilized arc were essentially the same as when conventional graphite cathodes were used. It was therefore possible to integrate the special cathode into analytical procedures by substituting for graphite cathodes. Moreover, each special cathode was used for 100 to 200 analyses with no intervening treatment. Author

N68-11524# Technische Univ., Berlin (West Germany).
CHEMICAL REACTIONS IN THE γ-IRRADIATION OF PHOSPHORUS TRICHLORIDE IN MIXTURES WITH POLYMERIZABLE OLEFINS [CHEMISCHE REAKTIONEN BEI DER γ-BESTRAHLUNG VON PHOSPHORTRICHLORID IM GEMISCH MIT POLYMERISIERBAREN OLEFINEN]
Manfred Renz 1967 62 p refs In GERMAN
(NP-16645)

The reactions of phosphorus trichloride, cyclohexylphosphorus dichloride, and dicyclohexylphosphorus chloride with styrene, of phosphorus trichloride with α-methylstyrene, and of phosphorus trichloride with isobutene under the effects of γ radiation and heat were investigated. In the radiochemical polymerization of styrene, phosphorus trichloride reduce the molecular weight and the gross reaction velocity; cyclohexylphosphorus dichloride and dicyclohexylphosphorus chloride increases the polymerization velocity significantly. α-methylstyrene which polymerizes only ionically as the pure monomer reacted in the presence of PCl_3 by a radical mechanism. The polystyrene formed in the presence of phosphorus trichloride contained chemically bound phosphorus. Author (NSA)

N68-11585 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISPLACEMENT OF CHEMICAL EQUILIBRIUM AT DISTURBANCE OF A MAXWELLIAN DISTRIBUTION [O SMESHCHENII KHIMICHESKOGO RAVNOVESIYA PRI NARUSHENII MAKSVELLOVSKOGO RASPREDELENIYA]

E. V. Stupochenko *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 147–151 refs (See N68-11548 02-34)

The author considers a stationary state of diatomic gas dissociation perturbed by sources of "fast" particles (also light). The intensity of the source and initial energy of "fast" particles enters into the result only through the temperature θ of the lower oscillating levels. The considered shift of chemical equilibrium is brought about by those particles whose initial kinetic energy is less than the energy necessary for the excitation of the lower oscillating levels of the molecule. If the characteristic time brought about by the source of varying macroscopic magnitudes is sufficiently great, then quasistationary nonequilibrious distributions of the various forms of energy are established. For an estimate of the role of similar perturbations in the kinetics of various processes, the author investigates the shift of chemical equilibrium in a system perturbed by sources of particles. Author

N68-11588 Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.

ANALYTICAL INVESTICATION OF RDX-HMX MIXTURES [ANALYTISCHE UNTERSUCHUNG VON HEXOGEN-OCTOGEN-GEMISCHEN]

H. Schubert, F. Volk, and H. Roszinski Nov. 1967 18 p refs Transl. into ENGLISH from Explosivstoffe (Germany), v. 14, no. 12, 1966 p 265–273

(TIL/T-5728) CFSTI: $3.00

The use of RDX (cyclotrimethylene trinitramine) and HMX (cyclotetramethylene tetranitramine) mixtures in explosive compounds and as components for rocket propellants is discussed, and their chemical similarity is pointed out. Various analytical methods for the determination of RDX and HMX are surveyed. Comparative analytical data are presented on the examination of RDX–HMX mixtures, using the colorimetric and titrimetric Fe II method, with gravimetric determination by dimethylformamide. As both RDX and HMX are crystalline, X-ray diffraction was used to analyze the RDX–HMX crystalline powder mixtures. It was felt that this method sould be particularly useful for serial tests in the production of RDX and HMX. M.G.J.

N68-11590 Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.

THE MECHANISM OF POLYCARBONATE PHOTODEGRADATION

Shogo Tahara Sep. 1967 12 p refs Transl. into ENGLISH from Chem. High Polymers (Tokyo), v. 23, no. 253, 1966 p 303–309

(TIL/T-5731) CFSTI: $3.00

The mechanism of degradation under UV light has been investigated using infrared and UV analysis. Two types of degradation are recognised, depending on the wave-length (l) with long UV (>280 m μ) to electron excitation ($n \rightarrow \pi^*$) transition breaks down the ether linkage and auxochromes of phenol, ethers, esters, acids are formed with depolymerization processes; (II) with shortwave UV (240≈280 m μ) the fine structure of the absorption spectrum is due to (π–π^*) forbidden transition of the benzene group. The carbonate linkage is attached as before, and also the isopropylidene linkage. Cross links are also developed and the polycarbonate becomes insoluble in methylene chloride. Author

N68-11621*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE COMPUTATION OF THE PARTIAL VOLUMES OF THE COMPONENTS IN SOLUTION

Joseph S. Rosen (Computer Sci. Corp., Huntsville, Ala.) Washington Dec. 1967 10 p refs

(NASA-TN-D-4199) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Described is a method for calculating partial volumes of the components in solution. The method is applicable to both aqueous and nonaqueous solutions of both electrolytes and nonelectrolytes. S.C.W.

N68-11629 Gt. Brit. Ministry of Supply, London.

ESR STUDIES OF IRRADIATED POLY 3,3-bis(CHLOROMETHYL) OXETANE

Kozo Tsuji, Hiroshi Yoshida, Koichiro Hayashi, and Seizo Okamuru 1967 6 p refs Transl. into ENGLISH from Nippon Kosh. Kobunsh. Kenkyu Kyokai Nempo (Japan), v. 6, 1964/1965 p 173–177

(TIL/T-5733) CFSTI: $3.00

The subject compound (also known as poly HBCMO and Penton) was irradiated with electron beams at −196°C and the ESR spectra measured at various temperatures. The characteristics and attribution of observed triplet and doublet spectra are reported. Similar phenomena with UV radiation are reported and compared. Author

N68-11757 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

UNIRRADIATED MTR FUEL ELEMENTS DISSOLUTION IN SEMICONTINUOUS FLOODED DISSOLVERS FOR ACID AND ACID-DEFICIENT FINAL CONDITIONS

G. Beone, R. Lojacono, G. P. Mazzoleni, and A. Moccia 1967 22 p refs

(RT/CHIA(67)-8) CFSTI: $3.00

Studies of the mercury-catalyzed nitric acid dissolution of nonirradiated MTR fuel elements in acid and acid-deficient conditions were carried out in a semicontinuous dissolver. Several runs were made varying feed acid concentration (in which all factors were constant) or varying acid feed flow rate or catalyst concentration to correlate these process parameters with metal dissolving rate and product concentrations. Under all conditions, the metal dissolving rate was directly proportional to the 0.87 power of the nitric acid feed molar rate and the 0.42 power of the catalyst concentration. The dissolution time decreased when the catalyst concentration was increased and the dissolution product changed from an acid to an acid-deficient condition. Author

N68-11852 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

DETERMINATION OF ^{54}Mn AND IRON IN LONG IRRADIATED STEEL SAMPLES. APPLICATION OF A LITHIUM-DRIFTED GERMANIUM DETECTOR

A. Moauro 1967 16 p refs

(RT/CHI(67)16) CFSTI: $3.00

Procedures for analyzing ^{54}Mn from irradiated materials containing iron are described. A lithium-drifted germanium detector was used to obtain high resolution gamma spectra. Results of measuring 1 mg of sample and 1 gram of standard ^{54}Mn solution indicate that for each pair of values the deviation from the average did not exceed 3%. Accuracy in determining iron content on some inactive steel samples using a phenantroline method was shown to be less than 2%. E.C.

N68-11873 Technische Hochschule Munchen (West Germany).

PHOTO AND RADIATION CHEMISTRY OF SOME TRIPHENYL METHANE DERIVATIVES [PHOTO- UND STRAHLENCHEMIE EINIGER TRIPHENYLMETHANDERIVATE]

Joerg Petry (Ph.D. Thesis) [1967] 87 p refs In GERMAN
CFSTI: $3.00

Triphenyl methane derivatives were evaluated for their photochemical behavior under cobalt 60 irradiation. Electron resonance measurements as well as infrared, untraviolet, and nuclear resonance spectra of various irradiated derivative solutions established the CH_2OH radical as the reaction partner for the color cation and thus the primary step of the discoloration process observed under radiolysis. Transl. by G.G.

N68-11877 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
UTILIZATION OF AN INDUCTION PLASMA IN THE ANALYSIS OF TRACES BY ATOMIC ABSORPTION
M. A. Biancifiori and C. Bordonali 1967 35 p refs
(RT/CHI(67)15) CFSTI: $3.00

Atomic absorption measurements performed using an induction plasma or plasma jet are reported. The plasma jet was obtained by ionizing a current of argon at atmospheric pressure in a tube of dielectric material such as glass or quartz. Equipment used and its operation are illustrated. Measurements demonstrating the influence of the gas composition and the presence of a reducing agent on the absorption were performed on chromium, both in water solution and in isopropylic alcohol-water solution. Other measurements were made to determine the effect of chemical interferences. Measurements were performed on instrumental character involving the continuous background from 3000 to 5000 Å due to the emission of plasma itself and of plasma in the presence of nebulized water. The actual advantages of plasma from the standpoint of application were still the lack of chemical interferences, the possibility of operating directly on the powders, and the possibility of operating in the far ultraviolet zone. S.P.

N68-11882# Technische Hochschule München (West Germany).
KINETIC INVESTIGATION OF THE MECHANICS OF THE TRANSGLYCOSIDATION OF N-GLYKOSIDES [KINETISCHE UNTERSUCHUNGEN ZUM MECHANISMUS DER TRANSGLYKOSIDIERUNG VON N-GLYKOSIDEN]
Gottfried Philipp (Ph.D. Thesis) [1967] 92 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Kinetic reactions of N-glucosides from p-nitralinine and p-toluidine were analyzed to obtain information on their trans-gluconization mechanism. Tritium marked amine exchange alcoholization methods proved that trans-glucanization velocity depended on the pH factor; N-glucosides, in the form of schiff bases, exchanged much faster than N-glucosides with a half-acetic ring possibility. Transl. by G.G.

N68-11883 Technische Hochschule München (West Germany).
ON THE POLYREACTION OF ISOPREN WITH LITHIUM ORGANYL IN DI-ETHYL ETHER [UEBER DIE POLYREAKTION VON ISOPREN MIT LITHIUMORGANYL IN DIAETHYLAETHER]
Karl Trukenbrod (Ph.D. Thesis) [1967] 166 p refs In GERMAN
CFSTI: $3.00

Spectroscopic analysis of the isoprene insertion into lithium butyl in ether solution established the velocity constant for the reaction: LiB+I→LiB at 20°C $k_{s,ether}=7.7$ 1/mol/sec. and the activation energy $A_k=13.3$ kcal/mol. The activation constant of $10^{10.8}$ 1/mol/sec was then computed. Transl. by G.G.

N68-11899 Technische Hochschule Munchen (West Germany).
STRUCTURE OF ORGANIC SULFUR COMPOUNDS, CONFORMATIONAL DEPENDENCE OF THE CHANGE EFFECT BETWEEN SULFUR-CONTAINING GROUPS AND AN ADJACENT π ELECTRON SYSTEM [ZUR STRUKTUR VON ORGANOSCHWEFELVERBINDUNGEN, KONFORMATIONSABHAENGIGKEIT DER WECHSELWIRKUNG ZWISCHEN SCHWEFELHALTIGEN GRUPPEN UND EINEM BENACHBARTEN π ELEKTRONENSYSTEM]
Walter Amann [1967] 162 p refs In GERMAN
CFSTI: $3.00

Examined were the sulfides, sulfur oxides, and sulfur dioxides of the benzothiacyclene and benzothiacyclenone series with five-, six-, and seven-membered anellated rings. The conformational dependence and the change effect between the sulfur-containing groups and the adjacent π-electron system was investigated using NMR, IR, and UV spectroscopic methods. The spectra were compared with those taken of benzocyclenes, benzocyclenones, and those of suitable open-chained compounds. Transl. by K.W.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-11006*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-47, VOLUME 2 FOR THE PERIOD JULY 1 TO AUGUST 31, 1967. THE DEEP SPACE NETWORK
30 Sep. 1967 159 p
(Contract NAS7-100)
(NASA-CR-90199; JPL-SPS-37-47, Vol. II) CFSTI: $3.00 CSCL 17B

Continuing research activities are reported in the following general areas: tracking and navigational accuracy analysis, communications research and development, communications engineering, and facility engineering and operations. N.E.N.

N68-11034* North Carolina State Coll., Raleigh.
STUDY OF RECTANGULAR-GUIDE-LIKE STRUCTURES FOR MILLIMETER WAVE TRANSMISSION Interim Progress Report, Aug. 1–Oct. 31, 1967
Frederick J. Tischer 15 Nov. 1967 52 p refs
(Grant NGR-34-002-047)
(NASA-CR-90310) CFSTI: $3.00 CSCL 09F

The theory of the artificial-dielectric H-guide is emphasized, representing one way to achieve low attenuation in an H-guide. As a specific structure, an array of rectangular disks was chosen. A theory was developed to give approximate equations for the computation of the field distribution in the waveguide. Results of the computation of the guide wavelength were compared with measurements carried out in a shorted section of the guide and satisfactory agreement was obtained. Equations for the attenuation were formulated on the basis of normalized parameters. The laminated dielectric slab represents also a form of artificial dielectric which improves loss characteristics. The attenuation of an H-guide with such a laminated dielectric was computed for normalized parameters equal to those of the corrugated guide. The attenuation coefficients of the various types of H-guides and a standard rectangular waveguide are compared. The program for the attenuation of the corrugated structure was extended to include computed data for various frequency values up to 150 GHz. The comparison of three types of H-guides and the standard rectangular guide was carried out at X-band (10 GHz). Author

N68-11079# Naval Research Lab., Washington, D. C.
MAXIMUM UTILIZATION OF FM SUBCARRIER BANDWIDTH
Charles F. White 17 Jul. 1967 9 p
(NRL-6449; AD-659946)

Central to the mechanization of the concepts in Maximum Utilization of FM Subcarrier Bandwidth, Abel, J. E., and Stine, P.T., NRL Report 6449, January 6, 1967, (AD-646 972), is a seven-element RC network credited to the present author. The purpose of this supplement is to provide information on a five-element RC network suited to the particular application and to provide an errata for the original report. TAB

N68-11095*# California Univ., Berkeley. Space Sciences Lab.
SOURCE ENCODING IN THE PRESENCE OF RANDOM DISTURBANCE
David J. Sakrison 2 Feb. 1967 9 p refs *Its* Ser. No. 8, Issue No. 4
(Grant NGR-05-003-143)
(NASA-CR-90295) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A modified source encoding is discussed, emphasizing the nature of the ergodic source. It is pointed out that the encoding procedure may be split into two steps, and that the simplification is a direct consequence of the choice of mean square error and does not apply in general. N.E.N.

N68-11099* Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM PHASE A: SUMMARY REPORT
18 Oct. 1967 85 p
(Contract NAS8-20256)
(NASA-CR-90305) CFSTI: $3.00 CSCL 17H

Details are presented on the development of the optical system, emphasizing the technology and applications. Astronomy, meteorology, remote sensing, and optical communications are the applications considered, and optical components, detectors, laser, technology, environmental effects, subsystems, and human factors are the technological areas investigated. Experiments are recommended for developing the technology in the areas of optical propagation through the earth's atmosphere, lightweight primaries in large diffraction-limited optical systems, and pointing and stabilization technology for a diffraction-limited astronomical telescope. The experiment integration, mission analysis, spacecraft integration, and subsystem analysis are discussed. The various demands of the total system are related for the most efficient use of resources, and the performance schedule and cost are considered. N.E.N.

N68-11108*# Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A, VOLUME 2, SECTION 3: EXPERIMENTS
18 Oct. 1967 355 p refs
(Contract NAS8-20256)
(NASA-CR-90302) CFSTI: HC $3.00/MF $0.65 CSCL 17H

The optical propagation experiments, the instrumentation, and the supporting activities are discussed in detail. The experiments include: heterodyne and direct detection, communication and tracking, and related instrumental correlation and measurement investigations. Ground station requirements and experiment procedures are also described. N.E.N.

N68-11206*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GROUND TRACKING RELIABILITY—A SUMMARY FROM GEMINI FLIGHTS GTA 9, 10, 11, AND 12
Ford Kalil May 1967 30 p refs
(NASA-TM-X-63030; X-507-67-197) CFSTI: HC $3.00/MF $0.65 CSCL 17H

This report contains data, in both tabular and graphical form, regarding the reliability of the ground network as configured for support of Gemini, in particular the down-times of the various network functions such as: acquisition, radar range, radar angles, timing, telemetry, commands, spacecraft communication (voice), on-site computer, NASCOM teletype and high speed data. The down times reported are only those which occurred during Gemini flights GTA-9, 10, 11, and 12; i.e., launch to splash. The down time is that time from when the function was reported "red" until it was reported "green." The percent of time down for these various functions varied from 0.4% for the NASCOM teletype to 4.8% for the C-Band radar ranging function. Author

N68-11233# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foregin Technology Div.
MEASUREMENT OF PARAMETERS OF PENCIL-BEAM ANTENNAS IN THE NEAR ZONE [K VOPROSU OB IZMERENII PARAMETROV OSTRONAPRAV LENNYKH ANTENN V BLIZHNEY ZONE]
A. Ye. Salomonovich, B. V. Braude, and N. A. Yesepkina 28 Apr. 1967 23 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSR (Moscow), v. 28, 1965 p 116–128
(Contract AF 33(657)-16408)
(FTD-HT-67-309; TT-67-63238; AD-660406)

The paper investigates the feasibility of near zone measurements of the side lobes and amplification coefficients of highly directional parabolic antennas whose diagrams have a width on the order of a few minutes. During the comparison of the directivity diagrams measured in the far and near zones the authors arrived at an expression which, as they found out after submitting their paper for publication, is for all practical purposes identical with the expression published earlier by J. J. Stangel and W. M. Yarnell. They also outline a method for the measurement of antenna amplifications using cosmic sources whose dimensions exceed the width of the main lobe (whose size was determined by preliminary measurements within the near zone). These methods are illustrated by the results of measurements (using the moon as the source) of the amplification of the antenna of the 22-meter RT-22 radiotelescope carried out by Fian in the millimeter wave band. TAB

N68-11268*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AUTOMATIC ELECTRONIC POLARIZATION TRACKING SYSTEM
Ralph E. Taylor Jun. 1967 23 p refs
(NASA-TM-X-55904; X-523-67-302) CFSTI: HC $3.00/MF $0.65 CSCL 17I

An automatic electronic method is described that continuously tracks, and measures to better than one-degree, the polarization orientation angle of a linearly polarized signal from a satellite such as ATS-F&G. Comparable systems utilize a mechanically rotating antenna feed. All linear polarizations are comprised of two circularly polarized components of opposite sense. This system measures the RF phase difference between the two oppositely polarized components to determine the linear polarization orientation angle. This report also describes an error analysis that defines orientation angle errors introduced by antenna ellipticity ratio and thermal noise. The polarization tracking technique described is applicable to the 2 GHz ATS-F&G proposed ground equipment and the 4 GHz Apollo Instrumentation Ship (AIS) SATCOM ground-terminal stations using a 30 foot diameter dish antenna with cassegrainian feed. Author

N68-11287# Mitre Corp., Bedford, Mass.
COLD LAKE RADIO PROPAGATION AND METEOROLOGICAL EXPERIMENT. VOLUME 1: DESCRIPTION OF A RADIO-METEOROLOGICAL EXPERIMENT MEASURE RAY-PATH BENDING IN THE TROPOSPHERE WITH A VERTICAL INTERFEROMETER

B. J. Starkey (EMI-Cossor, Ltd.), Lyall G. Rowlandson, and Gordon Fatum (RCAF) Aug. 1967 224 p refs
(Contract AF 19(628)-5165)
(MTR-118, V. 1; ESD-TR-67-357, V. 1; AD-659746)

The purpose of the experimental program described in this report was to determine the direct relationship between meteorological and radio-propagation measurements and then to evaluate the validity of radio-meteorological results for predicting the radio-propagation conditions. The meteorological information was derived from radiosonde measurements and airborne microwave refractometer data. The radio experiments were based on the vertical interferometer technique, in which a single airborne transmitter (S and L Band) was used to establish an interference pattern at the ground-based receiver, due to the combination of direct and lake-surface-reflected signals. Extreme accuracy in the measurements of the parameters involved, in particular in the interferometer experiment, was the keynote to success. The close agreement between the effective earths radius value obtained from the meteorological measurements and the interferometer technique indicates that this type of radio interferometer can provide meaningful and surprisingly accurate information on the radio propagation conditions. The results also indicate that the radiosonde data, if sufficient care is taken to calibrate it before launch, can give very satisfactory information about radio propagation conditions. Author (TAB)

N68-11318# RAND Corp., Santa Monica, Calif.
IMPROVING THE EQUALIZATION OF AN ARBITRARY ENVELOPE DELAY
M. I. Liechenstein Oct. 1967 25 p refs
(P-3670; AD-660100)

A small number of algorithms exists for obtaining realizable rational function approximations for arbitrarily prescribed envelope delays via RLCM networks. In most instances, these procedures are not completely satisfactory design aids, usually because either the entire equalizer design or its refinement is based on trial-and-error adjustments of the network singularity locations. In order to obviate these imprecise techniques for determining the final perturbations of the delay equalizer singularities, this paper expounds a readily programmed algorithm for achieving optimum (in a least-squares sense), realizable, rational function network approximants for an arbitrary envelope delay, given an adequate first approximation to the prescribed delay characteristic. Author (TAB)

N68-11333# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
CHANNEL CAPACITY AND CODING
Louis Dean Duncan (Ph.D. Thesis—New Mexico State Univ., University Park, Jul. 1967) Aug. 1967 82 p refs
(ECOM-5151; AD-660322)

The report presents original results in information. An improvement of Fanos theorem is proved. A sufficient condition for finite capacity for certain channels with additive noise is proved. An immediate corollary shows that the channel with additive Gaussian noise has finite capacity. A new technique for coding - the CONNECTED CODE - is defined and investigated. Author (TAB)

N68-11395# Naval Weapons Center Corona Labs., Calif.
A NONSTATISTICAL TREATMENT OF FM DEMODULATOR NOISE
Eugene R. Hill 15 Sep. 1967 34 p refs
(NOLC-724; AD-660404)

The report presents a nonstatistical evaluation of FM demodulator (discriminator) noise and provides an understanding of the characteristics of the observed FM demodulator output waveforms. The additive and subtractive properties of single- and double-sinusoid interference and random doise interference are defined and discussed. Author (TAB)

N68-11409*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
A SIMPLE THEORY OF DIPOLE ANTENNAS
Liang-chi Shen, Tai Tsun Wu, and Ronald W. P. King Sep. 1967 29 p refs
(Grant NsG-579)
(NASA-CR-90405; SR-10) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A simple and quantitatively accurate representation of the current distribution in a dipole antenna is derived. Numerical data are given and are found to be in good agreement with the experiment when $h \geq 0.15\lambda$. Author

N68-11471# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE THEORY OF COUPLED LINEAR ANTENNAS AND TRANSIENT RESPONSE
Trilochan Padhi Jul. 1967 45 p refs
(Contracts Nonr-1866(07); Nonr-1866(32); Grant NSF GK-273)
(TR-536; AD-660373)

The self and mutual admittances of an array of two long dipole antennas were obtained in terms of known functions by an approximate in method based on the Weiner-Hopf technique. The results are valid when $ka << 1$ and kb to the 2nd power/$h > 1$, where k is the wave number and a, b, and $2h$ are, respectively, the radius, separation, and height of the antennas. The current distribution along the antennas has also been obtained and several graphs of numerical results have been presented and discussed. To illustrate the application of these results, they have been used to calculate the transient coupling between the elements of the array in some simple cases. The report also includes a brief description of the effective terminal impedance of a widely separated, open-circuited two-wire line supporting the TEM mode. Author (TAB)

N68-11475*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A GENERAL METHOD FOR DESIGNING CIRCULAR ARRAY ANTENNAS TO OBTAIN QUASI-OMNIDIRECTIONAL PATTERNS
C. R. Cockrell and W. F. Croswell Washington Dec. 1967 21 p refs
(NASA-TN-D-4254) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A criterion is established for determining the number of sources needed around the periphery of a spacecraft to obtain small far-field pattern fluctuations; that is quasi-omnidirectional antenna patterns. The criterion assumes that the source pattern is expressible as a finite Fourier cosine series and that the circumference in wavelengths of the body is greater than or equal to 10. The number of sources obtained by using this criterion will always be adequate; however, if the representation of the source pattern is known, an optimum number of sources can be obtained. The criterion is not valid when the source pattern is isotropic. Two curves are given which relate the number of sources and the circumference of the body in wavelengths for 0.5 dB or less and 2.0 dB or less fluctuation. Author

N68-11531# Hamburg Univ. (West Germany).
DEVELOPMENT AND FABRICATION OF A COMPENSATOR MODEL FOR 3 CM WAVELENGTH Final Report
L. Niedermeyer, J. Rode, and M. Waechtler [1967] 13 p
(Contract AF 61(052)-274)
(AD-660143)

An investigation was made to develop and construct a rotating compensator by means of which the directional pattern of a circular array comprising ca. 12o aerials can be rotated so quickly that the bearing in the form of a stationary luminous indication can directly be read on a cathode-ray tube. In order to obtain such a stationary indication, the pattern has to be rotated ca. 10 times per second. This quick revolution can be achieved by

means of the projected compensator when its number of revolutions is considerably lower, for example only 10 times per minute. TAB

N68-11580* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MANNED SPACE FLIGHT NETWORK ANTENNA COVERAGE REPORT
T. M. Griffin (Bendix Corp.) H. B. Wall (Bendix Corp.), and J. J. Guzik (Bendix Corp.) Jun. 1967 32 p Prepared by Bendix Corp.
(Contract NAS5-9870)
(NASA-TM-X-63038; X-550-67-227) CSCL 09F

This report presents a method for determining the actual line-of-sight visibility contours for satellites at any orbital altitude from any ground station antenna. Natural horizon and man-made obstacles are considered in the method, which has been computerized because of the repetitive nature of the calculations. Sample maps are included which were made from the computer runoffs using preliminary site data. Author

N68-11620*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STANDARD FORMAT FOR ON-STATION DIGITAL RECORDING OF C-BAND METRIC TRACKING DATA
I. M. Salzberg Apr. 1967 17 p
(NASA-TM-X-63037; X-550-67-186) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A standard format was created for on-station digital recording of high-speed C-band radar metric tracking data, and IBM 7094 programs were written to perform the necessary conversions. The record used consists of a group of 13 word blocks recorded consecutively on magnetic tape; and each of these words is described. The first word is a Fortran word and is ignored; and the other words are for identification, time, range, range rate, azimuth, azimuth rate, elevation, elevation rate, and station status identification. The last two words remain open. M.W.R.

N68-11651* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GODDARD RANGE AND RANGE RATE SYSTEM PERFORMANCE WHILE TRACKING IMP-F
G. C. Kronmiller, Jr. and D. J. Zillig Nov. 1967 62 p refs
(NASA-TM-X-63040; X-571-67-532) CFSTI: $3.00 CSCL 17B

Tracking support for the IMP-F spacecraft was provided by the Goddard Range and Range Rate (GRARR) system using VHF equipment. The essential details of the VHF system, the GRARR signal characteristics, and the processing of the IMP-F tracking data from the tracking station to the computer are described. Several graphs are included which show the results obtained from each station while tracking IMP-F. These graphs show that most GRARR data are well within the minimum expected performance. These data from the GRARR sites have resulted in a knowledge of the IMP-F orbit to within 400 meters RMS in range and 0.1 meters per second RMS in range orbit. R.N.A.

N68-11709# Environmental Science Services Administration, Boulder, Colo.
ENVIRONMENTAL EFFECTS ON SHORT-RANGE COMMUNICATIONS
1967 104 p refs Tech. Study Group Meeting held in Boulder, Colo., 14–16 Mar. 1967; Sponsored by ARPA
(AD-660040)

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3. ELECTRICAL PROPERTIES MEASUREMENT TECHNIQUES 18 p (See N68-11711 02-07)
4. MATHEMATICAL AND PHYSICAL MODELING 8 p refs (See N68-11712 02-07)

N68-11710# Environmental Science Services Administration, Boulder, Colo.
ELECTRO-GEOGRAPHICAL CLASSIFICATION SYSTEMS
Seymour J. Deitchman *In its* Environ. Effects on Short-Range Commun. 1967 13 p ref (See N68-11709 02-07)

Studies were conducted to classify those elements of the natural environment of a given geographical area that affect the performance of short-range tactical radio systems, including air-to-ground and ground-to-ground systems, operated in that area. Such features as electrical characteristics of the earth's surface, natural vegetation, topographic features of the earth's surface, climatic characteristics, and natural radio noise were examined. Attempts were made to develop a methodology to classify various types of geographical regions in accordance with some combinations of the selected features. Studies were made to find the most desirable methods with which to scale characteristics of such features in electrically meaningful terms that could be most directly related to radio-system performance models. S.P.

N68-11711# Environmental Science Services Administration, Boulder, Colo.
ELECTRICAL PROPERTIES MEASUREMENT TECHNIQUES
In its Environ. Effects on Short-Range Commun. 1967 18 p (See N68-11709 02-07)

Techniques for measuring effective electrical properties of various types of terrain and the influence of surface conditions and terrain irregularities on these properties are examined. Parameters influencing performance of tactical telecommunication systems are defined as: terrain irregularities and roughness, surface soils, geological–lithological conditions, vegetation, and meteorology. Ground-wave propagation characteristics are defined, and methods of measuring direct electrical properties are enumerated. Techniques discussed include: use of probes, wave-tilt method, attenuation, the reflection coefficient method, comparison with mathematical models, and antenna impedance. The use of physical models in the study of measurement techniques for electrical properties is briefly discussed. Recommendations are made regarding measurement to determine effects of terrain irregularity and roughness, effects of vegetation, effective electrical properties of the ground, sky-wave propagation loss, and atmospheric noise. S.P.

N68-11712# Environmental Science Services Administration, Boulder, Colo.
MATHEMATICAL AND PHYSICAL MODELING
In its Environ. Effects on Short-Range Commun. 1967 8 p refs (See N68-11709 02-07)

A slab model of the jungle is examined, and the feasibility of using it as the basis of a mathematical model for characterizing point-to-point propagation is studied. Several recommendations are made regarding the slab model. First, the theory of propagation for an inhomogeneous planer slab should be developed. The analysis for propagation in a slab whose thickness varies in the direction of propagation should be carried out. The diffraction of the space wave and the lateral wave by a major topographical feature should be estimated. Regarding jungle anisotropy, the theory of propagation in bounded anisotropic media should be developed. The theory of propagation in a lumpy slab should be developed regarding the random nature of the fine-grain structure. The optimum orientation and location of antennas for best coupling into the lateral wave should be considered. It is also stressed that microwave and optical models be used, and that field experiments measure the electrical and physical quantities that enter into theoretical models. S.P.

N68-11713# Environmental Science Services Administration, Boulder, Colo.
PRESENT AND POTENTIAL MEASUREMENT PROGRAMS *In its* Environ. Effects on Short-Range Commun. 1967 30 p (See N68-11709 02-07)

Measurement programs related to communications systems required to support remote area need in situations involving counterinsurgency and internal security are explained. The systems include primarily vehicular, land-mobile and man-pack portable nets, fixed point-to-point circuits, and air-to-air and air-to-ground circuits. Present and future programs are enumerated and briefly explained. The status of the following ten programs is given: radio-wave propagation within a jungle-verification of lateral-wave and slab models, electrical properties of ground and cover, terrain irregularities and roughness, channel characteristics, multiple scattering effects on propagation loss, atmospheric and man-made noise and radio-frequency interference, antenna characteristics, ionospheric sky waves, polarization and depolarization, and terrain effects on signal distribution and cross-correlation. S.P.

N68-11775# Navy Electronics Lab., San Diego, Calif.
CIRCULAR-ARRAY RADAR ANTENNA Research and Development Report, Jan. 1965–Jun. 1966
J. H. Provencher and B. I. Small 7 Jul. 1967 74 p refs
(NELC-1501; AD-659984)

Preliminary study shows the feasibility of synthesizing Tchebyscheff-type radiation patterns with predictable side-lobe levels for a circular-array antenna with all elements fed. Results are contrasted with results of studies of circular-arc arrays of the cophasal type. Parameters and resulting pattern characteristics (system errors neglected) are given for both types of array. Author (TAB)

N68-11835# Philips Telecommunicatie Industrie N. V., Hilversum (Netherlands).
PCM TELEMETRY IN ELDO SATELLITE LAUNCHER
L. P. H. M. Korting *In* European Space Vehicle Launcher Develop. Organ. ELDO Tech. Rev., Vol. 2, No. 2 1967 p 99–120 Presented at the Natl. Telemetry Conf., Boston, 10–12 May 1966 (See N68-11832 02-31)

A description is given of the PCM telemetry equipment on board the 3rd stage of the ELDO Launcher EUROPA. Also the associated ground equipment is briefly explained. After mentioning some characteristics of the present system, some aspects are indicated, currently under study, which sould lead to a wider application of this system. Author (ESRO)

N68-11893# Environmental Science Services Administration, Boulder, Colo. Inst. for Environmental Research.
SPEEDING-UP OF HF RADIO TRANSMISSIONS AND BROADCASTS (WORLD WEATHER WATCH STUDY T.21)
Hiroshi Akima Mar. 1967 99 p refs
(PB-174842; IER-34; ITSA-34) CFSTI: HC$3.00/MF$0.65

Technical problems arising from the use of HF radio circuits for the global telecommunication system in the World Weather Watch (WWW) plan are reviewed. Propagation factors affecting HF communications are delineated, modulation–demodulation techniques as well as error control procedures to be used for HF high-speed data transmission are reviewed and consolidated, and technical problems concerning HF meteorological broadcasts are discussed. Several technical recommendations for the design of the WWW global telecommunication system are made, based on these studies. Author (TAB)

N68-11897# Environmental Science Services Administration, Boulder, Colo. Insts. for Environmental Research.
A TABLE FOR COMPUTATIONS OF ARRAY FUNCTIONS USING FINITE Z-TRANSFORMS
M. T. Ma and L. C. Walters May 1967 113 p refs
(ITSA-36; IER-36; PB-174843) CFSTI: HC$3.00/MF$0.65

Based on a new approach of applying finite Z-transforms to the analysis of radiation characteristics from an equi-spaced linear antenna array, a table of array functions expressed in closed form is established for many excitation functions whose finite Z-transforms are derivable from known material. Each array function is then numerically calculated for different numbers of elements (5, 10, 15, and 20) and for three typical element spacings: lambda/2, lambda/3, and lambda/4 with lambda as the free-space wavelength. These numerical data are finally plotted to give clear sets of radiation patterns from which any array designer can acquire all the necessary designing information as to the excitations, spacings, and number of elements required to achieve approximately certain radiation specifications. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-11056# Rand Corp., Santa Monica, Calif.
THE JOSS PRIMER
S. L. Marks and G. W. Armerding Aug. 1967 45 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5220-PR; AD-659734)

Introduction to JOSS, RANDs time-shared computing system for the beginning user with examples illustrating the systems basic elements, which can easily be learned without programming experience. Seated at a mobile console connected to a computer via telephone lines, the Primer reader follows the instructions step by step, duplicating examples, trying variations, and observing results. He types commands in imperative English sentences, instructing JOSS to perform procedures in arithmetic, algebra, trigonometry, and logic. JOSS responds with answers in user-prescribed formats and with error messages that help the user correct errors and resume processing. To extend the beginners knowledge of JOSS, the Primer concludes with lists of JOSS commands and functions and suggested reading in the JOSS literature. Author (TAB)

N68-11062 Royal Aircraft Establishment, Farnborough (England).
VARIABLE SYMBOL CATHODE-RAY TUBE GENERATOR
M. R. Green and C. Higenbottam Jun. 1967 21 p
(RAE-TR-67128) CFSTI: $3.00

The waveform generator described by this report produces suitable driving signals for electronic C.R.T. displays with the unique feature that the generated symbols may be easily changed by means of a patchboard and appropriate controls. The information contained in these signals comprises alpha-numeric symbols as well as general symbology such as scales, lines, etc. The writing speed is 25000 characters/second with a capability of 10000/second. Author

N68-11104 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
ANALYSIS OF SPECTRA PROGRAM FOR COMPUTER ODRA 1003 [ANALIZA VIDM. PROGRAM NA MASZYNE ODRA 1003]

A. Slizynski 1967 39 p refs In POLISH; ENGLISH summary (INP-533/PL)

Spectrum analysis was conducted using least square procedures. A computer program (MOST-1) which was used for the numerical analyses is presented. The program was written for the ODRA 1003 computer. Analytical results reveal the possibility of separating several superimposed spectral lines with normal distributions in the presence of a linearly alternating background. E.C.

N68-11137# Naval Weapons Lab., Dahlgren, Va.

A STRETCH COMPUTER PROGRAM TO PERFORM FOURIER ANALYSIS ON CORRECTED HERO TURNTABLE DATA

William A. Isaacs Aug. 1967 41 p ref (NWL-K-51/67; AD-660001)

A Fourier analysis is performed on corrected HERO turntable data. Specified harmonics may be plotted, with the original data, in polar coordinates, in order that the several harmonics can be compared with the original data. The option is provided for setting any combination of Fourier constants equal to zero, and plotting the resulting polynomial. Corrected data have undergone conversion from deflections to currents, and have been normalized to the maximum at the base of the radiating antenna. Author (TAB)

N68-11211# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPUTERS IN THE COMPLEX-AUTOMATION SYSTEMS OF ELECTRICAL POWER GRIDS [VYCHISLITEL'NYYE USTROYSTVA V SISTEME MOMPLEKSNOY AVTOMATIZATSII ENERGETICHESKIKH OB'YEDINENIY

V. M. Sin'kov, A. V. Bogoslovskiy, L. V. Fedotov, K. Yu. Fol'kman, and R. D. Tsiptsyura 3 May 1967 21 p ref Transl. into ENGLISH from Elektrichestvo (Moscow), no. 1, 1965 p 1–6 (FTD-HT-66-772; TT-67-63243; AD-660444)

A general discussion is presented of the possible role of computers in maintaining economy regimes at manual-controlled partially-automated power plants. The reducing of fuel consumption by 1% may save 150,000-200,000 rubles per 1,000 Mw installed capacity. The optimization of load distribution among power plants and of electrical and thermal load distribution among power-producing units may bring about a fuel saving of a few percentages which would quickly (from 3 months to 1.5 years) pay the cost of the computers making such an optimization possible. A combined system of frequency-and-active-power control is being developed by the Kiev Institute of Automation and Energosetproyekt (Moscow); the power-system operation will be based on predictive calculations for the system and automatic operating control at individual plants. The problems arising with power exchanges over low-capacity interconnection ties and d-c interconnections are noted. A sketch showing the recommended disposition of computers in a complicated power system is presented. An IPK-2 special computing device for determining fuel-consumption relative increments is mentioned. TAB

N68-11251# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FUNDAMENTALS OF COMPUTER ENGINEERING

P. M. Belash 27 Mar. 1967 464 p ref Transl. into ENGLISH from the book "Osnovy Vychislitel'noy Tekhniki" Moscow, Izd. Nedra, 1964 p 1–329 (FTD-TT-66-636; TT-67-63235; AD-660395)

This book contains the fundamental principles of analog and grid models and digital devices. The section on digital devices includes computers with programmed control, digital analyzers, and control computers. The problems of analog-code transformation and the combining of computing devices are considered. The solution of planning problems and the Monte Carlo method are presented in the section on methods of application of computing devices. The book is a text on the fundamentals of computer engineering and is presented in accordance with the syllabus of the course presented to the students specializing in Automation of Production Processes. It may be used by engineers operating in the field of process automation and in the application of computer technology. TAB

N68-11259# Stanford Research Inst., Menlo Park, Calif.

HIGH-INFORMATION-DENSITY STORAGE SURFACES Quarterly Report, 1 Apr.–30 Jun. 1967

Kendal T. Rogers and John Kelly Oct. 1967 35 p refs (Contract DA-28-043-AMC-01261(E)) (ECOM-01261-9; Rept.-9; AD-659789)

The program was devoted to the preparation and investigation of two novel kinds of electron-beam-addressable storage elements of submicron size and densely-packed arrays of these elements. One such element, called a micron-cap consists of an isolated microcapacitor at the bottom of a hole in a metal/dielectric/metal film sandwich. The other element, called a micron-ring, consists of an isolated metal film ring embedded concentrically with a hole in the dielectric of a multilayer metal/dielectric film sandwich. Storage and readout data on micron-cap elements were taken at low beam energies (near to the lower unity-crossover energy for secondary emission). System changes were made to allow higher sensitivity and higher-speed operation, as well as to facilitate high-beam-energy investigations. The mildly bakeable (400C) field emitter and molybdenum lens system and the associated commercial ultra-high-vacuum system have been assembled, the manipulators tested and found satisfactory, and beam measurements begun. Work on storage structures is being concentrated on attempts to wake regular arrays with a commercial electron probe; capability of producing approximately 10,000 elements in a field has been shown. Attempts are underway to make micron-ring elements using the same electron probe to polymerize electron-sensitive resist in the critical step of forming the ring. Author (TAB)

N68-11272# RAND Corp., Santa Monica, Calif.

THE JOSS NOTEBOOK

G. E. Bryan and E. W. Paxson Aug. 1967 135 p refs (Contract F44620-67-C-0045) (RM-5367-PR; AD-660095)

This is a reference guide for JOSS sophomores, who have had experience at a console and are familiar with the introductory JOSS literature. In addition to the basic tutorial material on JOSS language, commands, and functions, practical instructions are given on how to insert paper and change ribbons; typewriter settings; procedures for contacting JOSS; and actions to take in the event of console, line, or machine malfunction. Twelve annotated sample programs are included, together with an index that complements the heavy cross-referencing used throughout the notebook. In contrast to the more technical JOSS publications, these notes generally eschew detailed discussion in favor of informal interpretation and exemplary material. TAB

N68-11276# United Aircraft Corporate Systems Center, Farmington, Conn.

GRAPHIC DATA HANDLING TECHNIQUES Final Technical Report, Jun. 1966–Jun. 1967

Clifford W. Williams Jun. 1967 233 p (Contract DA-44-009-AMC-1831(X)) (SCR-351; AD-659807)

Techniques and equipment for handling graphic data were the subjects of the study. The graphic data were derived from line maps, color separation sheets, orthophotographs and contour sheets. Equipment was tested, wherever feasible, by implementing hardware and software to enable the on-line communication between a human operator and a digital computer. The human factors of handling cartographic data with a cathode ray tube display equipped with a light pen were studied to a degree sufficient to

obtain specific conclusions. An operational test system was used to obtain results of tests and to extrapolate the data obtained from these tests into possible system and equipment configurations. The test system consisted of a computational complex equipped with a graphical display with provision for human interface and augmented by a breadboard scanner-digitizer. The output of the system consists of an X-Y plotter capable of translating digital data into hard copy. Although the tests emphasized the human interface with a computational complex, the types of graphical data to be processed, the sources of this data, methods of handling data, and suggestions for solving the file conversion process were also investigated. These investigations are directly related to the graphical data handling techniques because it has been determined that any given technique or equipment will have many uses in the total cartographic system. Author (TAB)

N68-11279# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE APPLICATION OF FORMAC COMPUTER PROGRAMS TO AID IN THE SYMBOLIC FORMULATION AND SOLUTION OF ENGINEERING AND SCIENTIFIC PROBLEMS
S. K. Ferriera, L. H. Sobel, and B. G. Wrenn Jun. 1967 64 p refs
(LMSC-6-77-67-25; AD-659259)

The work applies a new tool that can symbolically perform mathematical operations such as differentiation, substitution, expansion of terms, etc. The tool is an experimental symbolic manipulation system called FORMAC (FORmula MAnipulation Compiler) which utilizes the IBM 7090/94 computer. Applications of FORMAC computer programs to problems in structural mechanics are presented. Author (TAB)

N68-11291 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATION AND INSTRUMENT MANUFACTURE Selected Articles
13 Mar. 1967 13 p refs Transl. into ENGLISH from Avtomat. i Priborostr. (Moscow), no. 3, 1965 p 26–27, 29–31, 35–37
(Contract AF 33(657)-16409)
(FTD-HT-66-737; TT-67-63063; AD-659664)

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2. IMPROVEMENT OF DIGITAL COMPUTER PHOTOREADING DEVICES N. A. Tkalenko and V. S. Kirdan p 5–9 (See N68-11293 02-08)

3. MAGNETOSTRICTION DELAY LINES A. M. Gorban', G. K. Gridin, G. M. Dodonova, E. L. Onishchenko, V. G. Sirotyan et al p 10–14 refs (See N68-11294 02-09)

N68-11292 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED DIVISION ANALOG COMPUTER
N. I. Krasnikov, P. F. Oleksenko, and S. B. Svechnikov *In its* Automation and Instr. Manuf. 13 Mar. 1967 p 1–4 refs (See N68-11291 02-08)

A theoretical description is presented on a high-speed analog computer for the division of unipolar pulses of arbitrary spectrum (0–10^5 cps), with a dynamic range of 300 for the divisor and 50 for the dividend. The analog circuit uses a silicon diode. Static and dynamic characteristics are given, and the circuit diagram is included. Author

N68-11293 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPROVEMENT OF DIGITAL COMPUTER PHOTOREADING DEVICES
N. A. Tkalenko and V. S. Kirdan *In its* Automation and Instr. Manuf. 13 Mar. 1967 p 5–9 (See N68-11291 02-08)

The disadvantages inherent in the use of punched tapes and photoreading devices for introducing information into digital computers are pointed out, and details are given on a method developed to eliminate the fixed number of digits. This is done by introducing small variations and additions to the circuits of the photoreading devices and using a special mark to indicate the boundary between consecutive numbers on the tape. The device consists of a counter, a circuit to set the cycle counter to zero, a shift-pulse shaper, and a write-pulse shaper. The circuit shifts the read numbers by the missing number of bits to the full bit capacity of the mantissa. M.G.J.

N68-11308# Naval Personnel Research Activity, San Diego, Calif.
APPLICATION OF AUTOMATIC DATA PROCESSING TECHNIQUES TO TASK ANALYSIS DIAGRAMMING Final Report
David A. Wilson Oct. 1967 37 p refs
(SRM-68-8; AD-660002)

The purpose of this exploratory project was to develop automatic data processing (ADP) techniques applicable to the construction and revision of task analysis diagrams during final development of a new system. The report presents a procedural guide to a simple experimental method of using automatic data processing in the production and revision of task analysis diagrams. Such techniques will be of benefit to both in-service and contract analysts in quickly and economically producing and revising such diagrams, as changes in system and hardware design are considered and incorporated into production-configured equipment. The resulting documents will provide a common informational tool to a variety of users in their effort to optimize the preparation and performance of the operator and technician. To avoid the necessity of security classification, the examples in this report are hypothetical, although they describe familiar types of equipment and procedures. A validation field test of this method, applied to an actual system under development, is planned for Fiscal Year 1968. Author (TAB)

N68-11351# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
THE ALCOR ILLINOIS 7090/94 POST MORTEM DUMP
Rudolf Bayer, David Gries (Stanford Univ.), Manfred Paul (Ill. Univ.), and Hans Ruediger Wiehle (Telefunken) Aug. 1967 22 p refs Sponsored in part by Deutsche Forschungsgemeinschaft, Technischen Hochschule and Illinois Univ. *Its* Inform. Sci. Rept.-3
(D1-82-0640; AD-660014)

A post mortem dump technique for programs written in Algol-60 is described which has been successfully implemented in connection with the ALCOR ILLINOIS 7090 Algol-60 Translator. This technique provides an intelligible analysis of an unsuccessful computation process in terms of the original source program. The basic analysis principles described in this paper are widely applicable to any configuration of programming languages and computing machines. Author (TAB)

N68-11432# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
THE PDPMAP ASSEMBLY SYSTEM
Thomas H. Johnson and Michael S. Wolfberg 10 Oct. 1967 54 p refs
(Contracts Nonr-551(40); AF 49(638)-1421)
(Rept.-68-11; AD-660048)

This report describes the PDPMAP Assembly System which is used to assemble symbolic programs written for a Digital Equipment Corporation PDP-8 or DEC-338 with up to 16-K memory locations. The system is implemented at the University of Pennsylvania on an IBM 7040 and DEC PDP-8 connected by a high-speed data channel (IBM 7904 and DEC DM03). The PDPMAP System uses the powerful assembler of a larger computer (IBM 7040 MAP Assembler) to quickly assemble programs for a small computer. Author (TAB)

N68-11499# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON CONSTRUCTION OF SERIAL-PARALLEL DIGITAL-DIFFERENTIAL ANALYZER [O POSTROYENII TSIFROUOGO DIFFERENTSIAL'NOGO ANALIZATORA POSLEDOVATEL'NO-PARALLEL'NOGO DEYSTVIYA]

A. V. Kalyayev and R. V. Korobkov 9 Jun. 1967 23 p Transl. into ENGLISH from the Publ. "Vychislitel'naya Tekhnika v Upravlenii" Moscow, Izd. Nauka, 1964 p 142–152 Presented at the 3d All-Union Conf.-Seminar on the Theory and Methods of Using Math. Models, 30 Oct.–3 Nov. 1967

(FTD-MT-66-136; TT-67-63240; AD-660418)

The digital differential analyzer proposed in the article contains only one integral, which assumes in succession during each integration step the role of all the necessary integrators; however, the information in the digital integrator is processed not sequentially, but in parallel code. Its advantages are claimed to be higher operating speed than possessed by the sequential–sequential differential analyzer, approaching the speed of the parallel–sequential operation (where there are many integrators as are required for the solution of the problem), but requiring much less equipment. The author discusses the possible block diagram of such an analyzer, the parallel-type digital integrator employed, the various individual circuit elements, and the scheme whereby the increments of the integrand are generated. TAB

N68-11533# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.

CONSIDERATION IN THE DESIGN OF A MULTIPLE COMPUTER SYSTEM WITH EXTENDED CORE STORAGE

Kurt Fuchel and Sidney Heller Jun. 1967 32 p refs Presented at the ACM Symp. on Operating System Principles, Gatlinburg, Tenn.

(BNL-11516; CONF-671003-1) CFSTI: HC $3.00/MF $0.65

The recent innovation of the use of large quantities of addressable (but not executable) fast random access memory in order to heighten the multi-programming performance of a multicomputer system is discussed. The general design of the hardware arrangement and the software components and functions of such a system are based on Brookhaven's future configuration of dual CDC 6600's sharing one million words of extended core storage. In the generalization of such a design, special emphasis is placed on estimating expected gains compared to the traditional configuration of separate and independent computers without ECS. An observation is made on the use of conventional slower speed random access storage devices in pace of the faster memory. Author (NSA)

N68-11546# Technische Hogeschool, Eindhoven (Netherlands).

ON THE HARMONIOUS CO-OPERATION OF ABSTRACT MACHINES

Arie Nicolaas Habermann (Ph.D. Thesis) [1967] 117 p refs

CFSTI: HC $3.00/MF $0.65

A multiprogrammed computer is able to perform a number of jobs simultaneously in contrast to a uniprogrammed computer on which programs supplied can be executed in a rigid sequentiality only. The main purpose of multiprogramming is to give a certain class of users common access to a computer, so that they can exploit the features of the machine and the implemented software jointly. Hence efficiency and economy are important motives for designing a multiprogramming system. However, even if the computer is not accessible in a conversational mode, multiprogramming leads to a more efficient and economical use of the computer plant, and the user will also profit by it. Users' programs are very different in computation time and their need of computing facilities may vary widely. On the one hand there are the programs that make use of the central processor intensively and on the other hand we have the programs of low intensity, programs that use the in/output devices mainly. Author

N68-11833 Polish Academy of Science, Cracow. Inst. of Nuclear Physics.

A VERSATILE AND MULTIPURPOSE AUTOMATIC PLOTTING SYSTEM [UNIWERSALNY UKLAD DO AUTOMATYC ZNEGO WYKRESLANIA KRZYWYCH]

Tadeusz Zaleski and Wiktor Olejarczyk Jul. 1967 12 p Submitted for publication

(INP-580/PS) CFSTI: $3.00

A plotting system based on a multichannel strip chart compensating recorder is described. The system consists of a digital-to-analog converter, a programmer, and recorder. The range of its application includes plotting of curves from multichannel analysers and various types of spectrometers. The accuracy is better than 1% and the maximum printing speed is 1 channel per second. The plotting system can also be used as part of a system which is plotting curves from a punched tape or, after connection to a simple control board, for hand-plotting. Author

N68-11791* Georgia Univ., Athens. Computer Center.

A DIRECTORY OF COMPUTER PROGRAMS AVAILABLE FROM COSMIC

1 Aug. 1967 30 p Suppl. 1 to Vol. 1

(NASA-CR-90548) CFSTI: $3.00 CSCL 09B

A compilation of abstracts that describe computer programs available from COSMIC is presented. Information on the machine requirements, number of cards, language, and program and documentation fees is included. C.T.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-11084# Varian Associates, Palo Alto, Calif.

INVESTIGATION OF ELECTRONIC INTERACTION WITH OPTICAL RESONATORS FOR MICROWAVE GENERATION AND AMPLIFICATION Triannual Report No. 1, 16 Mar.–15 Jul. 1967

Howard Jory Oct. 1967 20 p

(Contracts DA-28-043-AMC-01873(E)); DA-28-043-AMC-00480(E))

(Rept.-341-1 TriA; ECOM-01873-5; Rept.-9; AD-660317)

Design changes in the improved version (model 2) of the monotron oscillator are discussed. Cold test work is described which has led to what appears to be a good solution to the problem of orienting the resonances in the oscillator cavity for good coupling

to the output waveguide. Construction and initial experimental results with model 2 are described. Oscillation has been observed in resonances ranging from TE sub 6, 1, 1 through TE sub 9, 1, 1. TAB

N68-11088# Army Electronics Labs., Fort Monmouth, N. J.
SUPPRESSOR, TRANSIENT ELECTRICAL MX 7778/GRC
Bernard Reich Aug. 1967 18 p refs
(ECOM-2869; AD-659770)

Suppressor, Transient Electrical MX 7778/GRC was designed primarily to protect radio equipment from the effects of voltage transients in tracked vehicles. The prime component of this suppressor is a 36-volt zener diode array capable of reliably withstanding a reverse current of 120 amperes for 50 milliseconds. This device along with other auxilliary components comprises the electrical circuit of the transient suppressor. The report indicates the magnitude and duration of the voltage transients that can be suppressed by this suppressor for two electrical systems most commonly employed in tracked vehicles. Author (TAB)

N68-11101*# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
THERMIONIC CATHODE EVALUATION STUDY Interim Report, Jul. 1–Sep. 30, 1967
F. T. Hill 17 Oct. 1967 43 p Prepared for JPL
(Contracts NAS7-100; JPL-951810)
(NASA-CR-90327; PT-1615; IR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The diodes for pore-type dispenser, coated particle, and barium strontium cathodes were fabricated and exhausted for use in this study of the life capability of three different thermionic cathode types. The diodes with pore-type dispenser cathodes completed at least 576 hours of life burning and are operating satisfactorily at cathode temperature from 950°–1100°C and at cathode current from 0.2A/cm^2 to 1.6A/cm^2. The diodes using coated particle cathodes have been tested up to 0.275A/cm^2 at 850°C and appear satisfactory. Further tests above 850°C have been unsuccessful due to unexpected inhibited emission. The diodes using barium strontium oxide cathodes are at the preaging and testing stage, and appear likely to meet the maximum operating condition of 0.60 A/cm^2 at approximately 850°C cathode temperature. Author

N68-11113# Radio Corp. of America, Somerville, N. J.
THIN-FILM POLYCRYSTALLINE FIELD-EFFECT TRIODE Final Report, 1 Jul. 1966–30 Jun. 1967
M. L. Topfer, A. H. Danis, and A. K. Rapp Oct. 1967 28 p ref
(Contract DA-28-043-AMC-02432(E))
(ECOM-02432-F; Rept.-4; AD-659788)

The report includes data covering all work done on this contract. The last half of the program phased into the development of complementary thin-film transistor circuits, using tellurium for the P-type and cadmium selenide for the N-type semiconductors. The circuit used was a three-input NAND gate. To increase yield and to improve circuit operation and stability, a new mask was introduced into the fabrication procedure. Since this mask defined the source-drain lands and gap in one evaporation instead of two, the previous size and alignment problems were eliminated. The amount of penumbra was appreciably reduced because of smaller wire diameter. Faster switching was obtained, and circuit evaluation data gave evidence that many of the last circuits fabricated approached ideal performance. Author (TAB)

N68-11121# General Electric Co., Owensboro, Ky. Tube Dept.
300 MILLIWATT X-BAND TRIODE OSCILLATOR Quarterly Report, 1 Apr.–1 Jul. 1967
J. M. Connelly and L. F. Jeffrey Oct. 1967 42 p
(Contract DA-28-043-AMC-01795(E))
(ECOM-01795-6; QR-6; AD-660351)

Thirty type Y-1613-E and sixteen Y-1613-F triodes were assembled for evaluation during the quarter. The Y-1613-F triodes have larger cathode and anode diameters to evaluate the effect of this parameter on initial and life performance. Aging tubes at high current density and high plate dissipation under D-C conditions appears more harmful to tube characteristics than under R-F conditions. Further experimentation will be made because of possible advantages accruing from D-C preconditioning. Initial efforts to obtain the desired electronic tuning range were unsuccessful. A maximum range of 4 MHz was achieved. Author (TAB)

N68-11165# Naval Research Lab., Washington, D. C.
A NANOSECOND, HIGH-CURRENT PULSE GENERATOR USING PARALLELED AVALANCHE TRANSISTORS Interim Report
James P. Hansen 8 Sep. 1967 26 p refs
(NRL-6539; AD-659952)

A nanosecond, high-current pulse generator using paralleled avalanche transistors was designed, and its operating characteristics were determined. The generator utilizes the regenerative switching action of avalanching transistors to discharge capacitors through a low-impedance load. Transistors are selected for high collector-to-base diode breakdown voltage, BV sub CBO, low avalanche latching voltage, LV sub CER and fast avalanche switching. Control of the switching times of individual avalanche transistors is achieved by adjusting collector bias levels. This technique allows a variety of pulse waveforms to be generated, including pulse groups with adjustable pulse-to-pulse spacings. Output pulse waveforms are characteristic of a slightly underdamped RLC series circuit. Two models of the generator were developed using standard transistors and components. Peak pulse currents on the order of 40 amperes, with rise time less than 10 nsec and repetition rates greater than 10 kHz, were produced in loads of approximately one ohm. The generators are suitable for pulse modulating low-impedance devices such as GaAs room-temperature injection lasers. Author (TAB)

N68-11197# Radio Corp. of America, Somerville, N. J.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Quarterly Report, Mar. 1–May 31, 1967
Morton L. Topfer, Franz Huber, William H. Laznovsky, and Joseph H. Mitchell Oct. 1967 24 p ref
(Contract DA-28-043-AMC-01230(E))
(ECOM-01230-9; QR-9; AD-660319)

Thin film test resistors have been fabricated with different deposition times. Resistance vs. temperature tests have been made on some samples ranging from 6 to 570 ohms/square. A temperature coefficient of resistance (TCR) curve was plotted from -25 to +150C for samples fabricated in the same manner. The TCR value for these samples ranges from +1000 ppm to -70 ppm, depending upon the sheet resistance of the sample. Author (TAB)

N68-11217# Applied Technology, Inc., Palo Alto, Calif.
COMPUTER-AIDED DESIGN OF BROADBAND UHF TRANSISTOR AMPLIFIERS Final Report
Sidney C. Chao Ft. Monmouth, N. J. Army Electron. Command Sep. 1967 59 p refs
(Contract DA-28-043-AMC-02413(E))
(ECOM-02413-F; AD-659803)

Final report on second year of a study program dealing with computer-aided design of broad band UHF transistor amplifiers. The equivalent y-matrices for multistage amplifiers are computed with high frequency compensation and low frequency equalization applied to each stage. Matching networks for a 50 ohm band and

gain reduction resulting from mismatch at the input are investigated. A procedure for designing such amplifiers using digital computer techniques is outlined. Author (TAB)

N68-11220# Army Electronics Labs., Fort Monmouth, N. J.
STUDIES OF VACUUM BREAKDOWN BETWEEN MICRON-SIZED AREAS
Hans Hieslmair, Harry T. Guetzlaff, Martin L. Long, Barbara H. Mallery, and William P. Fitzpatrick Sep. 1967 19 p refs Presented at the 2nd Intern. Symp. on Insulation of High Voltages in Vacuum, Cambridge, Mass., 7–8 Sep. 1966
(ECOM-2870; AD-660289)

Vacuum breakdown between broad-area electrodes is initiated and occurs in localized areas of the electrodes. In the present report a new method of investigating such localized areas with a modified Muller Microscope is described and results are discussed. The method consists of scanning a metal surface with a small area electrode (anode) at a distance of a few microns, while a voltage of 1 to 3 kilovolts is applied. When scanning the surface, the distance between the electrodes is so adjusted that the current and voltage remain constant. In this manner a plot of the cathode surface is obtained, and micron-sized inhomogeneities can be detected. In contrast to microscopic or electron microscopic techniques, this method allows the observation of changes of the emission characteristics of a surface while high electric fields are applied. The experimental results indicate that changes of the electrodes occur even at current levels of 10 to the minus 10th power amperes when the surface is scanned for the first time. Apparent inhomogeneities of the cathode surface can be created or destroyed by current pulses of 0.1 microampere. Fowler-Nordheim plots give further information about these changes which eventually initiate vacuum breakdown. Author (TAB)

N68-11245# Varian Associates, San Carlos, Calif.
DEVELOPMENT OF LINEAR POWER TUBES Interim Development Report, 17 May–16 Aug. 1967
William H. Sain and Gordon E. Liljegren 25 Sep. 1967 52 p
(Contract N00024-67-C-1044)
(AD-660033)

Tube specifications, in MIL-E-1 format, were written for the two 500 watt (PEP) ultra linear tetrodes (the X2098-B and X2098-C) are attached. The design of the conduction cooled envelope was completed, with substitution of Beryllium Oxide (BeO) ceramic for Aluminum Oxide (Al2O3) ceramic. Calculated heat dissipation capability is 647 watts total power input with 100C maximum temperature gradient, tube-to-heat sink. Experiments were performed on modified 4CX5000 and 4CX3000 thoriated tungsten filamentary tetrodes. Two different types of modified 4CX5000s with special anodes were evaluated at 2 MHz with two-tone input. One type has an abrupt anode diameter change, while the second type has a conical taper over approximately one-half the anode length. The second type had a minimum signal-to-distortion ratio of -43 db, 500 to 5000 watts PEP output, when operated at the optimum conditions. The modified 4CX3000s contained an added auxiliary electrode in the cathode region. Theoretical analysis of the grid-plate transfer curves showed that a -15 db improvement in the third order signal-to-distortion ratio is possible if the auxiliary electrode is driven by an in-phase AC signal of the proper magnitude. Author (TAB)

N68-11252# Army Electronics Labs., Fort Monmouth, N. J.
PRELIMINARY INVESTIGATION OF PLASTIC ENCAPSULATED TRANSISTORS
Edward B. Hakim and Roland Canepa Sep. 1967 17 p refs
(ECOM-2879; AD-660349)

An evaluation of epoxy and silicone transistor packages was carried out on seven device types. All packages appeared favorable under standard MIL tests below 130C. However, a new realistic environmental test has been devised which appears to detect potentially unreliable devices in less thad 500 hours. The results from this test indicate that silicone packages are generally more desirable than epoxy. However, this can vary between manufacturers and some epoxy units have been found to be as stable as silicone, depending on the manufacturer. Results of tests are discussed as well as various problem areas. Author (TAB)

N68-11294 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETOSTRICTION DELAY LINES
A. M. Gorban', G. K. Gridin, G. M. Dodonova, E. L. Onishchenko, V. G. Sirotyan et al *In its* Automation and Instr. Manuf. 13 Mar. 1967 p 10–14 refs (See N68-11291 02-08)

Development and test data are presented on a series of magnetostriction delay lines, with delay times of 80, 640, and 2560 μsec, respectively. The design of each device consists of a flat metal base on which the sound conductor is housed in special comb-shaped Teflon holders and to which individual removable plates bearing the shaper, amplifier, and damping terminations are fastened. The transmitting transducer coil may be moved along the sound conductor within a 30 mm limit by knobs on the face of the panel, which contains a plug for connecting the delay lines to the circuit. M.G.J.

N68-11299*# Westinghouse Research Labs., Pittsburgh, Pa.
DESIGN AND FABRICATION OF AN ANALOG VOLTAGE TO DUTY CYCLE GENERATOR Interim Progress Report
Oct. 1967 14 p Prepared for JPL
(Contracts NAS7-100; JPL-951306)
(NASA-CR-90334; IPR-6) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This report describes continuing work on the design and fabrication of an integrated system which, because of the passive component requirements, includes both silicon diffused devices and tantalum passive components. A design layout for the complete AVDC system is presented which comprises four separated integrated circuit chips combined into one package. Details of the individual chip designs are given and the merit of the 'flip-chip' and conventional assembly methods are compared. The delineation technique used for the tantalum component formation is briefly described. Author

N68-11327# Hughes Research Labs., Malibu, Calif.
3.2 MILLIMETER WAVE OSCILLATOR Quarterly Progress Report, 1 Apr.–30 Jun. 1967
Robert P. Bryan Oct. 1967 21 p
(Contract DA-28-043-AMC-02225(E))
(ECOM-02225-3; QPR-3; Rept.-8; AD-659785)

The program involves the development of a permanent magnet focused 10 kW pulsed distributed interaction klystron which oscillates at 93.75 GHz and has been both environmentally and life tested. It is believed that this objective will be reached when the necessary improvements are made in an Exploratory Development Model tube developed under a previous contract. A permanent magnet has been designed and its procurement initiated. All of the diodes life tested have been operated in excess of 600 hours without degradation in performance. Tube subassemblies have been environmentally tested without incident, and these subassemblies have been incorporated into a finished tube to be tested further. All subassemblies for tubes to be constructed have been completed with the exception of the cavity structure/output coupler assemblies, and these are nearing completion. Short pulse modulator construction has been temporarily suspended pending resolution of a radiated energy problem. It is anticipated that all tasks to be performed under this contract will be completed within the next quarter. Author (TAB)

N68-11334# Clinton Instrument Co., Conn.
COMPARISON OF IMPULSE AND 3 KILOHERTZ SINE WAVE SPARK TESTING
Henry H. Clinton and Thomas W. Stewart (Pa. Insulated Wire Co.) 1967 23 p refs Presented at the 15th Intern. Wire Symp., Atlantic City, 29 Nov. 1967
(AD-660225)

Either the impulse or the high frequency sine wave spark test may be used under properly controlled conditions to match or improve on the results of water tank testing for the product tested. No simple way to determine the actual test voltage acting on the wire insulation over a range of product sizes was found when the annulated electrode was used. Electrode voltage drop was found to be a marked function of the D/d ratio, insulation material, insulation thickness, and wire centering in the electrode. Voltage drop across the air space in the contact (bead chain) electrode was found to be low compared with the voltage applied to the insulation when test voltages of at least 4000 volts RMS were used in the high frequency sine wave test. Strict control of both operator performance and spark test equipment performance is necessary to insure that the retest fault level in the finished product is below that which would be achieved in the water tank test. The quality of the product is much higher when a properly controlled spark test is substituted for the water tank test because of the elimination of undetected adjacent layer burns caused by failures in the water tank test. No indication of product damage due to repeated spark testing was found. Author (TAB)

N68-11381*# Varian Associates, San Carlos, Calif. Eimac Div.
ESFK 20–100 WATT S-BAND AMPLIFIER Quarterly Report
Erling L. Lien and Albert Mizuhara Oct. 1967 20 p Prepared for JPL
(Contracts NAS7-100; JPL-951105)
(NASA-CR-90338; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Low gain and thermal fading due to a coating of evaporated material inside the tube prevented normal testing of tube No. 3SR. Frequency drift of the penultimate resonator showed the need for a helix package which has improved heat dissipation and mechanical rigidity. The omission of copper plating from the helix has decreased the helix thermal dissipation. A brazed version of the helical resonator consisting of one brazed beryllia support rod and two unbrazed quartz support rods, yielded a (R_{sh}/Q) of 170 ohms in contrast to 210 ohms for the mechanically clamped version. However, the brazed version offers greater mechanical and thermal stability. Boron nitride was investigated as a substitute for the beryllia and quartz rods, but the effort necessary to develop a suitable BN supported helix assembly was judged to be beyond the present scope of this program. The redesigned lens No. 7 (tube No. 3L) is expected to operate closer to cathode potential than the previous lens (tube No. 3S) which operated at −4 kV. Author

N68-11394# Deutsch Co., Banning, Calif.
AN INTEGRATED TERMINATION SYSTEM
Roland Lawrence Dec. 1967 9 p Presented at the 16th Ann. Wire and Cable Symp., Atlantic City, 29–30 Nov.–1 Dec. 1967
(AD-659939)

An Integrated Termination System is one answer to the need for a standard for termination and interconnection of components. It is a concept that can be designed around basic modules, installation tooling, techniques and performance. Among other improvements it will: (1) Reduce the weight of the overall electrical system. (2) Provide sealed or non-sealed positive locking terminations throughout the system. Sealed terminations are water-, fuel-, and space - proof. (3) Increase reliability, because there is less chance of error. (4) Offer the first common-termination system designed for space vehicles, aircraft, and ground support equipment. (5) Reduce assembly and rework time as much as 65 per cent. (6) Reduce tool requirements by as much as 95 per cent. (7) Give freedom from the bookkeeping, training and logistic problems of soldering, wrapping, splicing, lugging or potting. Any interconnection can be made by using rear/insertion-rear/removal type connectors: wire splices, feedthrust, terminal junctions, bus bars, all with the same type of termination. From dial lights to computer inputs and power supply connections, the application of an Integrated Termination System is limited only by your imagination. Author (TAB)

N68-11473# Atlantic Research Corp., Alexandria, Va. Jansky and Bailey Engineering Dept.
DISCUSSION OF ROTARY JOINT CHARACTERISTICS FOR FREQUENCIES OUT OF THE DESIGN BAND Final Report
John J. Oliva Mar. 1967 29 p refs
(Contract NObsr-91373)
(Rept.-53-5309.06; AD-660208)

The report describes the basic principles of operation of rectangular/coaxial rotary joints and their out-of-band characteristics. The possible use of a rotary joint to provide a constant insertion loss with rotation to out-of-band frequencies is discussed. Measurements and data describing the resonant effects of a typical L-band rotary joint to specific out-of-band frequencies is presented. Two possible designs for high-power filters utilizing some of the characteristics of the rotary joint investigated are described. Author (TAB)

N68-11587*# General Precision, Inc., Glendale, Calif. Librascope Group.
STUDY OF FAILURE AND RELIABILITY IN MICROELECTRONIC DEVICES
H. M. Muncheryan 16 Oct. 1967 52 p
(Contract NAS12-72)
(NASA-CR-90425; TR-2-0459) CFSTI: HC $3.00/MF $0.65 CSCL 14D

Thermal cycling, step-stress tests, and operating life tests on four groups of integrated microcircuits resulted in eight different failure modes, which were verified by both direct observations and indirect failure derivations. Leakage current, voltage breakdown, and output saturation voltage were considered the three fundamental failure indicators of all the encountered failure modes. Major failure mechaniams identified were inhomogeneous aluminum metallization, faulty contact deposition, bubbles, pinholes in pyrolytic passivation film, and randomly occurring cracks or surface pits in silicon pellet. Surface reactions were considered to cause inversion layer formation, ionic migration at the Si diode surface, ionic entrapment at oxide defects, and metallization changes. Bond separation in two specimens was attributed to a brittle intermetallic formation, and a gate diode short initiated a microcrack in the p-n junction during bonding. M.W.R.

N68-11792* Rantec Corp., Calabasas, Calif. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REFRIGERATED TRANSMISSION LINE STUDY. VOLUME 1: MICROWAVE ANALYSIS AND MEASUREMENTS Final Report
K. C. Kelly 7 Apr. 1967 38 p refs Prepared for JPL
(Contract NAS7-100; JPL-951638)
(NASA-CR-90543; Rept.-66327-FR V. 1) CFSTI: $3.00 CSCL 09A

Waveguide and waveguide components refrigeration was studied to determine the extent to which antenna noise temperature might be reduced by cooling. Emphasis is placed on cooling a WR-430 waveguide to the temperature of 77°K, and on the problem of low level signal reception at Deep Space Instrumentation Facility stations at radio frequencies of 2295 MHz. Theoretical and

experimental losses of the WR-430 waveguide are described as a function of material, surface roughness, and protective finish. WR-430 loss calculations and measurements are applied to the estimation of losses in components with complex internal geometries, and these results are, in turn, applied to calculations of the noise temperature for a Cassegrain antenna feed system. Included are considerations given to the engineering problems of achieving cooling while maintaining component performance. C.T.C.

N68-11801# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.

THE DEVELOPMENT OF AN ALKALI METAL VAPOR ARC LAMP Final Technical Report

F. E. Gelhaus and S. W. Kessler Apr. 1967 44 p ref

(Contract DA-44-009-AMC-1632(E))

(ERDL-1632-F; AD-660452)

The report covers a twelve-month program to modify, fabricate and test alkali metal vapor arc lamps and to evaluate their potential as a visible and near infrared light source. Two lamp designs, designated Models K-503 and K-504, were evaluated during this program. Both models can operate with an input dc power from 70 to 300 watts, limited only by the ability to maintain a single liquid metal reservoir at low operating temperatures and the effects of oxidation at high temperature. These models both employ a hot cathode starting mode and use sapphire as the optically transparent portion of the containment vessel. One Model K-503 cesium vapor arc lamp operated to 3398 hours at a dc input power of approximately 225 watts. Author (TAB)

N68-11874 Technische Hochschule München (West Germany).

SHORT ACTIVE RECEIVING ANTENNAS [KURZE AKTIVE EMPFANGSANTENNEN]

Heinz Lindenmeier (Ph.D. Thesis) [1967] 21 p In GERMAN

CFSTI: $3.00

Structural and application aspects of short receiving antennas with integrated transistor elements are discussed. This integrated design places the first amplification step in the receiver portion of the antenna and thus increases signal transmission level between antenna and receiver to the antenna amplification level in contrast to passive antennas. Comparison of emitter, collector, and basic feed paths operations showed broadband receiver characteristics for a emitter and collector feed arrangement . A combined transistor circuit reached narrow band receiver resonances; electronically directed horizontal diagrams were obtained by proper phasing of electric and magnetic dipole signals. Transl. by G.G.

N68-11875 Technische Hochschule München (West Germany).

IS THE CHAIN-AMPLIFICATION PRINCIPLE OF TRANSISTORS POSSIBLE? [IST DAS KETTENVERSTAERKERPRINZIP AUF TRANSISTOREN ANWENDBAR ?]

Hans Koffler (Ph.D. Thesis) [1967] 24 p refs In GERMAN

CFSTI: $3.00

Performance calculations between amplifier chains and repeating amplifiers with tubes, transistors, and field effect transistors showed somewhat better results for repeating amplifier tubes at 30, 60, and 90 MHz bandwidths. Basic band resistance of the transistors and a high feedback capacity of the field effect transistors proved detrimental. Experimental research with repeating amplifier transistors obtained a constant output by using negative feedback in the required frequency. Transl. by G.G.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-11007* Brown Univ., Providence, R. I. Div. of Applied Mathematics.

THEORY OF DIFFERENTIAL EQUATIONS AND THEIR RELATIONSHIP TO DYNAMICAL SYSTEMS THEORY Progress Report, Apr. 1–Sep. 30, 1967

J. P. LaSalle 13 Nov. 1967 35 p refs

(Grant NGR-40-002-015)

(NASA-CR-90245; PR-6) CSCL 09C

Continuing, completed, and new research activities are briefly reported. Control theory is emphasized, and stability and stochasticity of dynamical systems are discussed. Also mentioned are functional and partial differential equations, integral equations, linear systems, perturbation methods, and boundary value problems. Theorems are proved throughout, and bibliographies are included. N.E.N.

N68-11039*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

STATISTICS OF SWITCHING-TIME JITTER FOR A TUNNEL DIODE THRESHOLD-CROSSING DETECTOR

Donald E. Nelsen (Ph.D. Thesis) 31 Aug. 1967 70 p refs

(Grant NsG-496)

(NASA-CR-90306; TR-456) CFSTI: HC $3.00/MF $0.65 CSCL 09C

As a step toward obtaining a procedure for modeling randomness occurring in electronic switching circuits, the switching randomness, or jitter, arising in a tunnel-diode switch was investigated. Distributions of the switching time were measured for a tunnel diode switching circuit that was driven by a slowly rising current ramp. A model was deduced from these measurements which relates the statistics of the jitter to the slope of the input ramp, the load resistance, and the tunnel diode characteristics in the vicinity of the current peak: the amount of shot noise, junction capacitance, and i-v relation curvature. For switching in the reverse direction, from the valley of the i-v relation back to the initial state, the switching randomness involves a different mechanism. Another model is presented for this case. This model relates the jitter to the 1/f noise that predominates in the valley region of the tunnel diode. Author

N68-11070# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.

FIXED-TIME FUEL-OPTIMAL CONTROL OF LINEAR STATE-CONSTRAINED SYSTEMS BY USE OF LINEAR PROGRAMMING TECHNIQUES

A. Frederick Fath and Thomas J. Higgins (Wisc. Univ.) Aug. 1967 25 p refs *Its* Inform. Sci. Rept. No. 2

(D1-82-0638; AD-660064)

A procedure is developed for obtaining a numerical approximation to the fixed-time fuel-optimal control for a state-constrained linear system. The constraints on both the state variable and the control variable are given by systems of linear inequalities describing convex polygonal sets which are allowed to be time-varying. The initial state and the final state can be explicitly given or specified as members of certain convex polygonal sets. The numerical approximation is obtained by reformulating the control problem into a form that is solvable by linear programming techniques. Author (TAB)

N68-11122# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
NEAR-OPTIMAL STOCHASTIC LINEAR CONTROLS
J. S. Meditch Sep. 1967 40 p refs Inform. Sci. Rept. No. 4
(D1-82-0647; AD-660056)

A class of optimal stochastic linear control problems is formulated in which the terminal time may be either fixed or free. The performance measure, which is to be minimized, is the expected value of any one element of a rather general set of scalar-valued functions of the instantaneous system error. The condition for optimal control is developed by utilizing results from optimal filter theory. It is found that this condition cannot be realized exactly in general, although there do exist some cases in which it can. An approximate or near-optimal control law which is physically realizable is then derived for the general case. The resulting control law is exceedingly simple to mechanize, requiring only forward-time solution of a matrix, Riccati, ordinary, differential equation with given initial condition. Expressions for assessing the performance of the near-optimal control relative to that of the nonrealizable, optimal one are derived. Two examples dealing with the problems of turbojet engine speed control and aircraft yaw control are included to illustrate the theoretical results. The presentation in the main body of the paper is for continuous-time systems. An outline of the development for discrete-time systems is given in the appendix for completeness. Author (TAB)

N68-11130# Army Electronics Labs., Fort Monmouth, N. J.
TOWARDS A THEORY OF AUTOMATED CIRCUIT DESIGN
William C. Cave Aug. 1967 27 p
(ECOM-2867; PR-1; AD-660285)

A theoretical method is developed to accomplish automated design (as opposed to automated analysis) of general electrical circuits. This method demonstrates that a properly formulated circuit design problem can be transformed into a standard mathematical programming problem. Practical application of this method enables the circuit designer to give the computer a circuit topology, constraints and tolerances on the devices, and other constraints derived from the system into which the circuit must work. If a feasible solution to the posed problem exists, the computer will select values of components which optimize the circuit according to given criteria. A designer with this facility can direct full attention to selection of a topology and derivation of meaningful constraints on the circuit. The theory allows either fixed or variable nominal values of components. Variable values are those selected by the computer. Fixed values are those imposed by the designer (e.g., the parameters of a particular transistor type). The theory also allows for fixed or variable tolerances, and constraints among tolerances as occur in integrated circuit design. This theory is developed from a simple definition of worst case design, a definition considered most meaningful for high-reliability design.
Author (TAB)

N68-11185# Yale Univ., New Haven, Conn. Dunham Lab.
ON TWO TIME-SCALES IN LINEAR SYSTEMS WITH SPECIAL REFERENCE TO ADAPTIVE CONTROL
Kumpati S. Warendra and I. Joseph Shapiro 31 Oct. 1967 30 p refs
(Contract N0014-67-A-0097-0004)
(CT-16; AD-660514)

A comparison is made of various methods presented in the literature for treating Linear systems with time-varying parameters. These variations are considered to arise both from small-amplitude signals of arbitrary frequency and also from signals which are much slower than the dominant signals of the system. Two time-domain approaches and one frequency-domain approach are shown to be equivalent, resulting in identical truncated series solutions, expressed in terms of a single time variable. The method is extended to the case where the slow variations are expressed as functions of a second-time-variable. The result is shown to be equivalent to a two time-scale approach described in the literature. A general unified approach is suggested encompassing all the above methods, whether for single- or double-time-scale series solutions. Author (TAB)

N68-11198# Aerospace Corp., El Segundo, Calif. Electronic Div.
THE APPLICATION OF MODERN COMPUTING TECHNOLOGY TO CONTROL SYSTEM ANALYSIS AND DESIGN PROBLEMS, OCTOBER 1966–MAY 1967
T. C. Coffey Jun. 1967 158 p refs
(Contract AF 04(695)-1001)
(TR-1001(2307)-20; SAMSO-TR-67-9; AD-660133)

The analysis and design of multiloop, multivariable, linear control systems requires the use of computers. Algorithms are introduced for applying frequency response, time response, and root locus methods to such systems with the aid of a digital computer. A digital program, AUTO, is described which, through the use of a gradient optimization scheme, automatically synthesizes compensation for multiloop continuous and digital control systems so as to achieve a desired open-loop frequency response. The application of analog, digital, and hybrid computers to the simulation of control system time-domain performance is discussed and the strengths and weaknesses of each type of simulation are highlighted.
Author (TAB)

N68-11200# RAND Corp., Washington, D. C.
SOME ANALYTICAL ASPECTS OF DELAY EQUILIZATION
M. I. Liechenstein Oct. 1967 29 p refs
(P-3663; AD-659725)

Many of the prevailing studies in network synthesis are devoted to approximately reproducing a prescribed amplitude, phase, or transient response. A design objective of renewed interest relates to another pertinent aspect of circuit behavior, its envelope or group delay. The extant techniques of arbitrary delay approximation, however, are sparse and lacking as practical design algorithms. As an aid to evolving more satisfactory delay equilization schemes, therefore, this discussion elucidates fundamental relationships governing the envelope delay of a passive, linear, lumped-constant network. In so doing, several salient classical results are examined and extended, and new analytical expressions are elicited which connect envelope delay to rational functions identifiable as the transfer functions of realizable networks. Author (TAB)

N68-11214# Vitro Corp. of America, Eglin AFB, Fla. Vitro Services Div.
TOPICS IN NOISE
Herman K. Scherer Air Proving Ground Center Oct. 1967 25 p
(Contract FO8635-68-C-0001)
(APGC-TR-67-131; AD-660093)

The paper discusses basic noise problems which effects the performance of electronic devices. The noisiness of black boxes is described first in terms of the noise figure concept and then from the noise temperature approach. Equations are given for calculating the noise output of typical electronic devices as individual stages and as stages in tandem. Author (TAB)

N68-11273# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MICROPOWER ERROR-CORRECTING REDUNDANT CIRCUIT DESIGN
Robert E. McMahon and Nathaniel B. Childs 23 Aug. 1967 28 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-483; TN-1967-27; AD-659750)

A simple error-correcting circuit design employing a majority charge technique is described. Use of a pulse-powered design, conventional integrated circuits, and a majority charge technique provides a reliable error-correction method for redundant digital networks at micropower levels. The design procedure is described in terms of operating margins. Practical system implementation is also provided. Author (TAB)

N68-11324# Wisconsin Univ., Madison. Mathematics Research Center.
RECENT ADVANCES IN NETWORK FLOWS
T. C. Hu Jun. 1967 11 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-753; AD-660505)

The present paper surveys important results in the theory of network flows which are not included in the book Flows in Networks by Ford and Fulkerson. The survey is divided into three areas: (1) Shortest paths and minimal cost flows, (2) Multi-terminal flows, (3) Multi-comodity flows. Author (TAB)

N68-11344# Army Electronics Labs., Fort Monmouth, N. J.
STATIC AND DYNAMIC PERFORMANCE OF MICROPOWER TRANSISTOR LOGIC CIRCUITS. PART 2: MICROPOWER LOGIC CIRCUIT DESIGN
L. F. Wagner and J. D. Meindl Jul. 1967 84 p refs
(ECOM-2863, Pt. 2; AD-659805)

The report describes the design of six basic saturating logic circuits, including TRL, DCTL, DTL and TTL, for operation at microampere current levels. The exact worst case design equations are derived and written for each circuit to include component tolerance, device variation with temperature, and immunity to external noise voltage. Mathematical expressions for power dissipation and average propagation delay time are derived from equivalent circuits under nominal operating conditions. With the aid of a digital computer, the range of valid worst case designs is determined. The evaluation of these designs for minimum power dissipation and minimum propagation delay time concludes that DCTL and TTL offer the best overall micropower performance. Author (TAB)

N68-11357# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
REALIZABILITY CONDITIONS FOR NEW CLASSES OF THREE-ELEMENT-KIND NETWORKS
Jonny Andersen (Ph.D. Thesis) 1 Aug. 1967 127 p refs
(Contract DA-36-039-AMC-03200(E))
(TR-447; AD-659835)

The assumption of ideal elements places a practical limitation on the theory of Modern Network Synthesis. To extend the theory to cope with more realistic elements, several new classes of three-element-kind networks were studied. Realizability conditions were derived for driving-point impedances of these networks. This was achieved through physical arguments leading to a property of driving-point functions which was called the difference function. It was shown that the positiveness of the difference function over an appropriate portion of the s-plane represents a necessary and sufficient condition for a rational function to be realizable as the driving-point impedance of a given network class. The most notable contribution was perhaps the establishment of a general theory for networks composed of resistance and reactance with semiuniform loss (i.e., all inductors have one Q; all capacitors have another Q). This theory is almost as comprehensive as that now available for RLCT networks. Author (TAB)

N68-11411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE APPLICATION OF MODIFIED POINT TRANSFORMATION METHOD IN THE STUDY OF NONLINEAR IMPULSE SYSTEMS
Ching-hsuan Hsueh 28 Apr. 1967 20 p refs Transl. into ENGLISH from Tzu Tung Hua Hsueh Pao (Peking), v. 2, no. 2, 1964 p 61–70
(FTD-HT-67-244; TT-67-63253; AD-660498)

Generalized describing-function method is derived by continuing the differential phase plane method and describing function method. The new method can be used for the analysis of self-vibration of second order nonlinear pulse system. Comparing this new method with other existing methods, the new method not only provides much simpler procedures for constructing the intersecting loci, it can also solve other problems that cannot be answered by other methods such as determination of stability regions and the half period of self-vibration. It is proved that all self-vibrations are stable with the only exception being when kTp = 0. Analysis indicates that there can be 2 or more stable self-vibrations in the nonlinear pulse system and also complex self-vibrations. A detailed study of second order nonlinearity in a pulse system of a servo mechanism was conducted with the construction of loci using the method of isoclines to determine the stability regions of self-vibration. TAB

N68-11440 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANALYSIS OF FAST TWO- AND MULTIFOLD COINCIDENCE CIRCUITS INFLUENCED BY STATISTICAL TIME SPREADS [ANALIZA SZYBKICH UKLADOW KOINCYDENCJI DWU- I WIELDKROTNYCH PRZY UWZGLEDNIENIU STATYSTYCZNEGO ROZRZUTU OPOZNIEN]
Jozef Kalisz (Ph.D. Thesis) 1967 103 p refs In POLISH; ENGLISH summary
(INR-806/III/E) CFSTI: $3.00

The work deals with the problem of determination of statistical parameters of coincidence circuits: resolving time, jitter breadths and efficiency. Analysis is carried out at the assumption of Gaussian jitter distributions. Two new methods ("slope method" and "point method") are presented allowing determination of these parameters if a single empirical coincidence curve is given. Utilizing the digital computer allowed for obtaining the tables and clear diagrams. The methods have been presented for double and triple coincidence circuits and next generalized for multifold coincidence circuits. The concepts of "coincidence surface" and "coincidence hypersurface" are discussed. The use of the presented theory has been illustrated by some numerical examples. Author

N68-11444 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SWITCHING OF HIGH CURRENT IMPULSE GENERATORS WITH FOUR ELECTRODE SPARK GAPS [ZALACZANIE GENERATOROW UDAROW PRADOWYCH ISKIERNIKAMI CZTEROELEKTRODOWYMI]
Andrzej Jerzykiewicz and Marek Sadowski 1967 45 p refs In POLISH; ENGLISH summary
(INR-823/XVIII/PP) CFSTI: $3.00

Technical requirements on spark gaps at parallel action are discussed and triggering devices for four electrode spark gaps are described. Operating characteristics of time delay to breakdown and jitter time versus applied dc voltage and triggering voltage are given. There are also described the results of research on parallel action of spark gaps in the six-section impulse current generator. Author

N68-11458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DYNAMICS OF SELF-ADAPTING ANALOG SYSTEMS

A. A. Krasovskiy 13 Jun. 1967 532 p refs Transl. into ENGLISH of the Publ. "Dinamika Nepreryvnykh Samonastraivayushchikhsya Sistem" Moscow, Gosydarstvennoye Izd., 1963 p 1–465 (FTD-HT-66-252; TT-67-63237; AD-660394)

Contents: Information in control processes and intended use of self-adapting systems; Examples of self-adapting analog automatic control systems; Methods of minimax search; Dynamics of continuous minimax control; Forced minimax control processes; Synthesis of continuous minimax control systems; Self-adaptive control systems for continuous production processes; Self-adaptive data-processing systems; Stabilization of the dynamic characteristics of automatic control loops; Minimax systems for stabilization and optimization of the dynamic characteristics of control loops. TAB

N68-11513*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THEORETICAL ERROR ANALYSIS OF A DOPPLER RANGE-RATE AND PHASE-MODULATED RANGE TRACKING SYSTEM

Kenneth J. Bures and Gerald L. Smith Washington Dec. 1967 47 p refs

(NASA-TN-D-4267) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A detailed error analysis is presented for a particular type of range and range-rate tracking system. Results are given in the form of analytical expressions for the variances of the various types of errors that affect tracking data. The expressions are written in terms of system parameters so that they can be applied to a wide range of specific systems and tracking situations. The majority of the errors considered are random, but some are bias like and others are deterministic. The equations given constitute an error model from which data weighing factors can be obtained for use in data processing for the construction of the best estimate of the trajectory of a space vehicle. Author

N68-11602 Joint Publications Research Service, Washington, D. C.

RESULTS AND DEVELOPMENT TRENDS IN AUTOMATION, TECHNICAL CYBERNETICS RESEARCH

Otto Benedikt *In its* Rept. of the Tech. Sci. Dept. of the Hung. Acad. of Sci. 30 Nov. 1967 p 1–21 (See N68-11601 02-34)

Automation and technical cybernetics research efforts in Hungary and, more specifically, at the Hungarian Academy of Sciences are summarized in terms of three specific problem areas around which programs center. The preparation of optimum direction algorithms, primarily relating to computer control of continuous industrial processes, is considered; and coordinating efforts among many interested scientists are noted. Direction identification problems are also discussed, as are digital techniques and logic systems for exact and approximation automation methods. The frame of reference for this presentation is achievement that will enhance the national economy. M.W.R.

N68-11789*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STATISTICAL TESTS FOR SIGNAL DETECTION

James C. Morakis Washington Dec. 1967 83 p refs

(NASA-TR-R-273) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Some of the problems arising from maximum likelihood decision systems in time varying channels are solved by first introducing simple statistics which are functions of the outputs of the correlators of an n-ary detection system. Then methods are developed to use the statistics to a) attach a confidence level to each decision in a maximum likelihood decision system, b) control the error rate at the expense of data rejection, and c) define the critical region for an optimum generalized decision system. These improvements and optimizations are accomplished by taking advantage of the information already available in the sample representing the outputs of n-ary detection systems. The six statistics that are investigated are simple functions of the largest correlator output, the mean, the standard deviation, the sample mean, the sample variance, the next to the largest correlator output, and the smallest correlator output. Author

N68-11806*# Brown Univ., Providence, R. I. Center for Dynamical Systems.

EXISTENCE THEOREMS FOR OPTIMAL PROBLEMS WITH VECTOR VALUED COST FUNCTION

Czeslaw Olech (Polish Acad. of Sci., Cracow) Nov. 1967 48 p refs

(Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270) (NASA-CR-90531; TR-67-6) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A mathematical discussion is given of the optimal control problem. The problem is identified as minimizing the vector valued cost function, and the theorems pertaining to it are proved. N.E.N.

N68-11862* Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

OPTIMAL CONTROL IN THE PRESENCE OF MEASUREMENT UNCERTAINTIES

John Jacob Deyst, Jr. (Ph.D. Thesis) Jan. 1967 171 p refs (Grant NsG-254-62)

(NASA-CR-90504; TE-17) CFSTI: $3.00 CSCL 09C

This research is concerned with the optimal feedback control of linear stochastic systems. Particular emphasis is placed on the solution of problems for which the cost is nonquadratic and the plant state cannot be determined by the controller without error. The plant and feedback controller are treated as discrete systems in time. It is shown that the optimal feedback control can be determined as a function of the mean plant state, conditioned on the measurements available to the controller. Recursion formulas are derived which permit the determination of this optimal control function. The theory is applied to the problem of minimum fuel midcourse guidance of spacecraft. Both fixed time of arrival and variable time of arrival guidance schemes are investigated, and an Earth–Mars mission is used as the basis for computing numerical examples. It is found that the optimal control is determined by a threshold. If the estimated state lies outside the threshold, the optimal control corrects to the threshold. Inside the threshold the optimal control is zero. Author

N68-11870*# California Univ., Los Angeles. Dept. of Engineering.

THE APPLICATION OF THE METHOD OF QUASILINEARIZATION TO THE COMPUTATION OF OPTIMAL CONTROL

Garrett Paine Aug. 1967 109 p refs

(Grant NsG-23-62; Contract F04701-68-C-0001; Grant AF-AFOSR-699-67)

(NASA-CR-90749; Rept.-67-49) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The method of quasilinearization (generalized Newton–Raphson method) is applied to optimal control problems in general, and to specific problems where either the control cannot be solved for explicitly or where there are bounds on the control. A quadratic convergence proof; computational techniques; and properties of the brachistochrone are presented. Equations of motion for two cases of the reentry trajectory problem are used for computations. L.S.

N68-11884# Technische Hochschule München (West Germany).
THE PRODUCTION OF VERTICAL IMPULSE LOAD OF HIGH AMPLITUDE [DIE ERZEUGANG STEILSTER STOSSSPANNUNGEN HOHER AMPLITUDE]
Hermann Kaerner (Ph.D. Thesis) [1967] 178 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Theoretical and application problems in generating unipolar high voltage impulses and their utilization in power generations are discussed. Compared are measured and calculated breakdown times of various induction currents and line transmissions for a power generator show that two parallel power curcluts form rapid front and slower background currents. This assures a short spark gap induction current of minimal breakdown probability. Transl. by G.G.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-11010 Suomalainen Tiedeakatemia, Helsinki (Finland).
EXPERIMENTS ON THE BASE OF INTERFERENTIAL TESTING AT TURKU-TUORLA [EXPERIENCES SUR LA BASE D'ESSAI INTERFERENTIELLE A TURKU-TUORLA]
Y. Vaeisaelae 1967 43 p refs In FRENCH *Its* Ann. Acad. Scientiarum Fennicae Ser. A. VI. Phys., 248

Details are given on the optical measuring instrument and the interferometric techniques used in determining the star coordinates in the vicinity of the North Pole. The coordination axis was calibrated at the University of Turku, in Tuorla, Finland. Positioning and calibration of the silver-faced mirrors are described, along with the compensation mechanisms which are incorporated. Observational data are assessed, and the measurements are calculated. Temperature variations are considered, and their effects on luminosity were found to be minimal. It is pointed out that zeroed-in azimuthal observations may be used for short periods of time to determine celestial coordinates. Transl. by M.G.J.

N68-11087* National Aeronautics and Space Administration, Washington, D. C.
GROUND INSTALLATIONS FOR DEVELOPMENT, QUALIFICATION, AND CHECKOUT TESTING OF THE APOLLO SPACE VEHICLE
John H. Disher 1965 92 p refs Presented at the 16th Ann. Meeting of the Intern. Astronautical Congr., Athens, 12–18 Sep. 1965
(NASA-TM-X-60664) CSCL 22D

The ground test plan for the Apollo Saturn V space vehicle is outlined, and the requirements and capabilities of some of the major ground installations utilized in developing, qualifying, and performing factory checkout and acceptance testing of the vehicle, are described. These include launch vehicle stage; engine test; space vehicle dynamic test; ground test; vibration and acoustics test; propulsion test; and lunar landing research facilities. An overall sequence of the Apollo mission is depicted. L.S.

N68-11199 Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
ADVANCED AERODYNAMIC TEST FACILITIES AND THE "SLINGSHOT" CONCEPT
Robert W. Perry Jun. 1967 71 p refs
(Contract Nonr-839(25))
(PIBAL-1026; AD-660511)

Mechanical acceleration of an encapsulated relatively dense, neutral gas is suggested for the gas supply of a non-conventional wind tunnel. Design considerations for such a novel aerodynamic test facility, christened Slingshot, are discussed. Particular attention is concentrated upon the possibility of shock formation within the confined gas during acceleration. The relationship of the widely-used shock compressor within the general class of adiabatic compressors and its limitation for the production of increased temperatures of dense gases are also explained. The potential advantage of kinematic staging for advanced aerodynamic test facilities is stressed. Author (TAB)

N68-11260 Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
ANNUAL REPORT, 1966 [VERSLAG OVER HET JAAR 1966]
[1967] 81 p refs In DUTCH and ENGLISH
CFSTI: $3.00

Administrative operations and progress in research and development projects are reported for the aerospace laboratories, the scientific advisory committee, and the Netherlands delegation at the Advisory Group for Aerospace Research and Development (AGARD). Summaries of aeronautical research are given covering the following: (1) development of the Fokker F 28 Fellowship project; (2) material fatigue and crack propagation; (3) aerodynamics, wind tunnel testing, airframe strength, and flutter; (4) combustion and propulsion; (5) flight mechanics and aircraft operations; (6) development of a rocket sonde project and of the European space vehicle launcher project ELDO; and (7) development of equipment related to these projects. K.W.

N68-11428# Ohio River Div. Labs., Cincinnati.
DEVELOPMENT STUDY FOR A HELIPAD STANDARD MARKING PATTERN
T. H. Morrow, Jr. Sep. 1967 86 p
(TR-4-67; AD-660359)

The report presents the results in the development of a recommended marking pattern for helipads. The objective of the study was to determine the marking pattern which would best fulfill requirements which were established on the basis of current practices, discussions with helicopter pilots, and helicopter operational observations. Field tests were conducted following laboratory observations and scale-model studies. Those requirements which most influenced final selection of the marking pattern were (1) Visual Flight Rules conditions (daytime), (2) recognition of the pattern from one mile, and (3) a five-degree minimum approach angle. Elements of pattern size and contrast gained significance as a result of field test evaluation. In order that the selected pattern most effectively meet the requirements, minimum overall pattern size and line width were recommended. Also, to emphasize the importance of good contrast, it was recommended that the marking pattern be white, edged with a black border unless the surface is sufficiently dark that the border is not needed for good contrast. The selected pattern was recommended as an Army standard for helipad marking and, in addition, is being considered as a national and international standard. Author (TAB)

N68-11430# Army Engineer Research and Development Labs., Fort Belvoir, Va.
AUTOMATED CHARGE–DISCHARGE FACILITY FOR STUDY OF DIRECT-CURRENT ELECTRICAL POWER SOURCES

Edward J. Dowgiallo, Jr. Aug. 1967 22 p refs
(AERDL-1908; AD-660336)

The report describes a facility consisting mainly of a controller for charging and discharging electrical power sources. The facility also includes a data storage system and data reduction equipment. The controller has five modes of operation: Constant current and constant voltage charge, constant power and constant current discharge, and an open-circuit voltage period. Each mode has certain preset end points. A comparator monitors cell voltage continuously and can override the end points, causing a printout of ampere-hours, watt-hours, or time. All modes of operation and end points can be set up by diode pins in program boards, and the constant power, voltage, or current level is programmed by a clip-card reader. Twenty-five different modes and sixteen different levels can be preprogrammed in any sequence. Author (TAB)

N68-11507# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

SRL METEOROLOGY SYSTEM

R. E. Cooper and B. C. Rusche Sep. 1967 11 p ref Presented at the AEC Inform. Meeting on Meteorol., Chalk River, Can., 12–14 Sep. 1967
(Contract AT(07-2)-1)
(DP-MS-67-68; CONF-670931-2) CFSTI: HC$3.00/MF$0.65

The facilities used in the Savannah River Laboratory Meteorological Program and operational experience with the program are described. The primary facility being used is a TV tower that is instrumented to a height of 1200 ft. Another tower has instruments to 110 ft. The system, in service for about two years, provides wind speed, wind direction, standard deviation of wind direction, and temperature data once every 3 to 5 min at each tower. Output data are punched on paper tape in a form suitable for computer processing. The instruments have performed satisfactorily since correction of the initial problems detected during checkout of the equipment. Sensors mounted on the 1200-ft tower are serviced every 3 months unless major damage occurs. The major hazard has been the melting and falling of ice during warm periods of the winter months. No problems due to pickup have been encountered at the TV tower. Availability of the equipment has been better than 90% since February 1966. The system is expected to continue in service for about another year. Author (NSA)

N68-11656*# Computing Devices of Canada, Ltd., Ottawa (Ontario).

EXPERIMENTAL INVESTIGATION OF A SABOT STRIPPING METHOD FOR A 0.5 INCH LIGHT GAS GUN Final Report

J. R. B. Murphy 24 Oct. 1967 41 p refs
(Contract NAS8-20529)
(NASA-CR-90503; Rept.-7457/R1, Sup. 1) CFSTI: $3.00 CSCL 14B

An experimental program to develop a sabot stripping method for a 0.5 inch light gas gun is described. Sabots carrying spherical projectiles of various densities and sizes were employed, at velocities in excess of 20,000 feet per second. Dispersion of the sabot fragments was required within a length of less than two feet. It was found that a combination of a gasdynamic decelerator tube and a cruciform configuration of wedge shaped tungsten pins provided best results. The decelerator tube separated the sabot and projectile, and the pins interfered with the sabot to produce high energies and pressures which dissipate the sabot material. Author

N68-11704# National Research Council of Canada, Ottawa (Ontario).

VERIFICATION OF THE NRC 3,000-POUND STANDARD DEADWEIGHT MACHINE

S. R. Gwilt and K. J. Fracke Jun. 1967 68 p refs
(NRC-9772; LR-483) CFSTI: HC$3.00/MF$0.65

Initial calibration of a new 3,000-lb. deadweight machine is described. The machine was installed in the Structures and Materials Section of the National Aeronautical Establishment, National Research Council, Ottawa, in November 1966, to complement the force standards facility offered by the 100,000-lb. standard deadweight machine installed in 1960. The new machine is capable of loading in 10-lb. increments from 20 lb. to 3,000 lb., the applied load being known to within approximately 3 parts per million. Author

N68-11755# National Research Council of Canada, Ottawa (Ontario).

PROFILES AND POWER SPECTRA OF SOME OFF-RUNWAY LANDING AREAS

G. M. Lindberg Mar. 1967 54 p refs
(NRC-9635; LR-478) CFSTI: HC$3.00/MF$0.65

Profiles of three semi-prepared grass landing strips and four snowdrift-covered lakes have been measured and are analyzed by standard statistical methods. Autocorrelation functions show that the profiles are truely random when long wavelength trends are removed by a specially developed filter, and probability density calculations indicate that the roughness distributions are essentially Gaussian in nature. The power spectra found are all similar in shape and the snowdrift-covered lakes are three to four times rougher than the grass strips. A method of estimating aliasing errors due to discrete sampling is presented. Idealized spectral curves have been fitted to the two types of surfaces. Author

N68-11769* Computing Devices of Canada, Ltd., Ottawa (Ontario).

DEVELOPMENT OF A MICROMETEOROID SIMULATION DEVICE, VOLUME 1 Final Report

P. L. Cowan 24 Oct. 1967 120 p refs
(Contract NAS8-20529)
(NASA-CR-90506; Rept.-7457/R1, V. 1) CFSTI: $3.00 CSCL 14B

The micrometeoroid simulation facility is intended to provide the capability of launching projectiles of known mass in the velocity range from 20,000 to 50,000 ft/sec. The facility consists of a conventional light gas gun of 0.5 inch barrel diameter, with a third-stage accelerator attached to the muzzle. The gas gun accelerates a primary projectile which enters the accelerator; the energy of the primary projectile is used with gas-dynamic processes to accelerate a secondary projectile. Theory and experimental results are given for the third-stage accelerator and for an initial accelerator concept which operates on a principle similar to that of the light gas gun. It was found that the performance was limited by energy losses. Also developed was a method for determining the mass of the secondary projectile while in flight after acceleration, but before impact. K.W.

N68-11778 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).

MUFFLER FOR NOISE LEVEL IN AIR INTAKE SUPPLY SYSTEMS IN STEEL PLANT INSTALLATION [SILENCIADOR DESTINADO A ATENUACAO DO NIVEL SONORO EXISTENTE NO SISTEMA DE ALIMENTACAO DOS DUTOS DE AR NOS FORNOS INSTALADOS EM USINA DE ACO]

L. X. Nepomuceno 29 Apr. 1967 22 p In PORTUGUESE; ENGLISH summary
(TN-6704.288)

The report presents the results of sound levels in the different ISO scales, the octave band analysis and the directivity of the noise source, with considerations of the legal implications of the noise level. The report presents the design of a muffler silencer for sound attenuation to the admitted legal levels. Author

N68-11780 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
SOUND LEVELS, ACCELERATION LEVELS, OCTAVE BAND ANALYSIS OF BOTH AS FOUND IN INDUSTRIAL CHEMISTRY INSTALLATION [MEDIDAS DE NIVEIS GLOBAIS E ANALISE EM FAIXAS DE OITAVAS DO BARULHO E DA ACELERACAO DE PAR TES MOVEIS EM INSTALACAO QUIMICA INDUSTRIAL]
L. X. Nepomuceno 29 May 1967 31 p In PORTUGUESE; ENGLISH summary
(TR-6705.289) CFSTI: HC $3.00

This report describes the installations, indicating the points where measurements in total noise levels and octave band analysis of sound and acceleration of movable surfaces were carried out. The results are presented in tabular and graphical form and some comments are made regarding the extremely high noise levels in industrial installations such as the present one. Author

N68-11865# Computing Devices of Canada, Ltd., Ottawa (Ontario).
DEVELOPMENT OF A MICROMETEOROID SIMULATION DEVICE Quarterly Report
13 Jul. 1967 14 p ref
(Contract NAS8-20529)
(NASA-CR-90505; Rept.-7457/QR8-MR24; QR-8) CFSTI: $3.00 CSCL 14B

Firings for accelerator development, dismantling for shipping, and installation are reported for a micrometeoroid simulation device. Four accelerator firings made to investigate the performance of secondary projectiles made from magnesium–lithium alloy are described. Disc-like projectiles were employed, and in order to achieve a sufficiently low secondary projectile mass one possible failure mode was studied. The mode chosen was the effect of dynamic flexing due to the unsteady stress wave propagation system existing in the projectile during the initial acceleration. For each finite portion of the disc a set of axial and radial displacements were used to determine the resultant force. The acceleration of each particle was calculated and by a forward integration in time the displacements after one time interval were obtained. S.P.

N68-11900* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATLAS/CENTAUR LAUNCHER TESTS
Jack Humphrey and Charles Eastwood Washington 1967 57 p
(NASA-TM-X-52352) CFSTI: $3.00 CSCL 22D

Simulated launch tests of Atlas/Centaur were conducted to study a method of reducing launcher transient loads. Launcher of similar design as that used during Atlas/Centaur launches and a sled simulator of the Atlas booster duplicated the launch motion during the first 30 inches of vehicle rise and the loads generated by interaction of the launcher parts and the Atlas vehicle. In this launcher, a pneumatic hold down cylinder is used to prevent rise-off of the vehicle immediately after ignition of the engines. To eliminate the transient loads, the hold down cylinder was modified to allow the main hold down pressure to be biased by a lower reverse pressure on the under side of the hold down cylinder piston. Reverse pressure in the hold down cylinder decreased transient loads on the strut and the launch vehicle to negligible values. No damage to launcher or the vehicle should result from this modification. The probability of the vehicle colliding with unmovable launcher parts is increased because contact between the vehicle and the launcher kick strut is terminated before control of the vehicle is given to the autopilot, allowing uncontrolled yaw or roll of the vehicle. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-11014 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
AN EXPERIMENTAL STUDY OF LAMINAR SEPARATION BUBBLES
S. K. Ojha Apr. 1967 55 p refs
(AE-186A) CFSTI: $3.00

An experimental study of short separation bubbles has been made and a composite picture of the bubble is presented. The bubbles have been produced on a flat plate and the effects of separation Reynolds number as well as pressure gradients have been investigated. Author

N68-11075# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
SELECTIVELY VENTILATED RING WING HYDROFOILS Final Report
A. J. Acosta and R. B. Wade Aug. 1967 66 p refs
(Contract Nonr-220(54))
(E-138.2; AD-660379)

Experiments were made on a ring wing having a chord-diameter ratio of one-half with a profile section consisting of a 10 percent Clark Y airfoil. Measurements were made of the force characteristics of this ring wing in fully wetted flow for several Reynolds numbers and angles of attack; in fully wetted flow these observations agreed with similar previous results on fully wetted ring wings. A portion of the circumference of the ring was also ventilated by the controlled injection of air to provide a cross-force. The magnitude of this cross-force varies with extent of ventilation and with the rate of injection of air. With less than approximately 11 percent of the trailing edge of the wing so ventilated, the cross-force corresponds to the wing in fully wetted flow having an angle of attack of nearly three degrees. Experiments were also made on the rapidity with which this cross-force could be built up at the start of injection or terminated after the ventilation had been established. The termination of the cross-force is very quick and amounts to a time approximately required for the flow to travel a distance of a few wing chords. The build-up process on the other hand is considerably slower, and it appears to be a dynamic one but the scaling laws for this phenomenon are not yet established. Author (TAB)

N68-11086 Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
COMPRESSIBLE BOUNDARY LAYER STABILITY BY TIME INTEGRATION OF THE NAVIER–STOKES EQUATIONS AND AN EXTENSION OF EMMONS' TRANSITION THEORY TO HYPERSONIC FLOW
A. L. Nagel Sep. 1967 61 p refs
(D1-82-0855; Rept.-119)

Two separate studies related to transition are presented. Boundary layer stability calculations based on the direct numerical integration of the Navier–Stokes Equations with respect to time are described. The purpose of reformulating the stability problem in the present manner is to avoid the inherent linearization of the classical method. The study that led to the present results is viewed as the initial phase of the development of a numerical method capable of treating transition itself, although it is too early to say just how far into the transition zone the method can be extended. The first phase of such a study consists of developing adequate

numerical techniques for the integration and for representing boundary conditions. Numerical experiments and comparisons between the present calculations and those obtained by other methods show the numerical integration scheme reported here to be highly accurate. For example, it is shown that the amplification rates given by the present method agree with those given by the classical method over a range of Reynolds numbers encompassing both branches of the neutral curve. Author

N68-11087# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
EXPERIMENTS ON IMPACT PRESSURE PROBES IN A RAREFIED SUBSONIC GAS STREAM
A. K. Sreekanth Sep. 1967 30 p refs
(D1-82-0656; Rept.-120)

The performance of impact pressure probes (having a length to internal diameter ratio of about 10) in a rarefied subsonic gas stream was studied. The range of Knudsen numbers (based on internal diameter of the probe) was 1.0 to 15.0 and the range of the speed ratios 0.1 to 0.6. All experiments were conducted in low density gas dynamics facility using nitrogen as the test gas. Author

N68-11107# North American Rockwell Corp., Anaheim, Calif.
BOUNDARY LAYER TRANSITION ON CONES AND SPHERES AT SUPERSONIC SPEEDS—EFFECTS OF ROUGHNESS AND COOLING
Edward R. van Driest and Charles B. Blumer Jul. 1967 39 p refs
(Contract AF 49(638)-1442)
(C7-2007/020; AFOSR-67-2048; AD-660131)

Results of experiments on boundary layer transition as affected by single roughness elements on cones and spheres in supersonic flow are reviewed and analyzed. Results for the cone includes cooling, whereupon it is found that cooling decreases transition roughness size linearly with wall temperature. The sphere was uncooled, however the curvature of the surface had to be taken into account to collapse the data for various sized roughness elements. Relationships are presented which correlate roughness, Mach number, cooling, and body curvature effects on transition. Author (TAB)

N68-11112# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
A NEW SOLUTION OF THE BOUNDARY LAYER EQUATION AND ITS APPLICATION
Fuat Odar Aug. 1967 33 p refs
(CRREL-RR-217; AD-660339)

Solutions of the boundary layer equation for an unsteady flow have previously been obtained for only a few boundary conditions such as those which exist in suddenly accelerated or uniformly accelerating flows. In the paper a general solution using the method of successive approximations for an arbitrarily accelerating flow is presented. The solution, which is expressed in an integral form including the acceleration as a chosen function of time, is valid for both two-dimensional and axially symmetrical flows. An example is presented in which the variation of velocity outside of the boundary layer is a fourth degree polynomial in time multiplied by a function depending on shape of object. Author (TAB)

N68-11149# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
SELF-ADJUSTING FEEDBACK LOOP FOR MECHANICAL SYSTEMS TO INFLUENCE FLOW IN TRANSITION, PART 1
O. H. Wehrmann Aug. 1967 15 p refs
(D1-82-0632)

The stability of a laminar boundary layer on a flat plate can be influenced by an active flexible wall. The problem to adapt the wavelength of the traveling surface wave automatically to the boundary layer wave was solved by using an electronic self-adjusting feedback network. Author

N68-11158# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
FUNDAMENTALS OF TURBULENCE
Joshua Menkes and C. M. Tchen (Natl. Bur. of Standards) Oct. 1967 37 p refs *Its* Res. Paper P-283
(Contract DAHC15-67-C-0011)
(IDA/HQ-66-5163; AD-659997)

The fundamental aspects of turbulence are reviewed. Great emphasis is laid on an intuitive development of the characteristic features of homogeneous and isotropic turbulence. The limited generalizations to other types of turbulence are briefly explored. No attempt is made to introduce experimental data in support of the theoretical notions presented. A brief bibliography is included. Author (TAB)

N68-11187# General Applied Science Labs., Inc., Westbury, N. Y.
THE ADDITION OF SECONDARY SHOCK CAPABILITY AND MODIFICATIONS TO THE GASL THREE-DIMENSIONAL CHARACTERISTICS PROGRAM. PART I: ANALYSIS AND RESULTS Final Report
Fred Petri 16 Aug. 1967 37 p refs
(Contract DA-01-021-AMC-14889(Z))
(TR-653; AD-659808)

The report describes the addition of secondary shock capability to the GASL 3-D characteristic solution, and several other modifications. Among the important additional modifications is the addition of new nose solutions which provide initial data for the 3-D characteristics program. One is an improved blunt body solution for a sphere and the other is a cone at angle of attack solution. Author (TAB)

N68-11188# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
VISCOUS FLOW IN A CYLINDRICAL TUBE CONTAINING A LINE OF SPHERICAL PARTICLES
H. Wang and R. Skalak Jul. 1967 75 p refs
(Contract N00014-67-A-0108-0003)
(TR-1; AD-657956)

Three cases of viscous flow in a circular cylindrical tube containing an infinite line of spherical particles equally spaced along the axis of the tube are considered: axial translation of the particles, flow past a line of stationary particles, flow of fluid and particles under an imposed pressure gradient. The fluid is taken to be incompressible, Newtonian and the linearized equations of creeping flow are used. The case is an idealization of blood flow in capillaries where the diameter of the red blood cells is of the same order as the diameter of the capillary itself. The results may also be of interest in sedimentation, fluidized beds, and groundwater flow. An exact solution in the form of an infinite series of singularities at the center of each sphere is developed and evaluated numerically for a range of sphere radius to tube radius of zero to 0.9. The drag on each sphere, the pressure drop and typical streamline patterns are given. The results show that the drag and pressure drop for a given size of sphere decrease as the spacing between spheres increases and for spacings more than one tube diameter, there is little interaction between spheres. Author (TAB)

N68-11248# Naval Ordnance Lab., White Oak, Md.
ANALYSIS OF DATA FROM AN EXPERIMENTAL INVESTIGATION OF THE TURBULENT WAKE BEHIND A CONE AT MACH 5

William C. Ragsdale 25 May 1967 64 p refs
(NOLTR-67-86; Aerodynamics Res. Rept.-280; AD-660364)

Values of Mach number, static pressure, static temperature, velocity and density in the turbulent wake of a 9 degree cone at Mach 5 were obtained in an experimental investigation. The experimental results were used to calculate streamlines in the wake and values of the turbulent eddy viscosity. A map of the flow field around the 9 degree cone is presented. The influence of the wake shock wave on the development of the turbulent wake close to the body is discussed. Experimental values of the eddy viscosity are compared with several empirical eddy viscosity models from the literature. Author (TAB)

N68-11267# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
MATHEMATICAL THEORY OF STEADY COMPRESSIBLE SWIRL FLOWS WITH CLOSED STREAMLINES AT HIGH REYNOLDS NUMBERS
Karl G. Guderley and David E. Greene Jul. 1967 280 p
(ARL-67-0140; AD-659743)

The paper presents a theory of axi-symmetric steady compressible swirl flows in which the stream lines are closed, under the assumption that the Reynolds number is large. In principle the flow field is determined by the equations for an inviscid flow; but, if the stream lines are closed, additional conditions arise which are primarily determined by the dissipative terms. They arise by purely mathematical arguments as the solvability conditions for the approximation of the next order in a development with respect to the reciprocal of the Reynolds number. These conditions can be interpreted in physical terms. Various transformations are carried out to prepare the equations for numerical work. The mathematical structure of the operators occurring in the solvability conditions and its relation to the parameters which are suggested by physical considerations is studied in detail. The solution for the potential vortex is compatible with this approach only if the viscosity coefficient is constant with the Prandtl number of 1/2. Author (TAB)

N68-11278 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
A STUDY OF TWO-DIMENSIONAL SECONDARY FLUID INJECTION
R. Ravindran, T. A. Diab, Roddam Narasimha, and S. Hariharan Oct. 1966 51 p refs
(AE-165A; Rept.-66-FM-7) CFSTI: $3.00

Experiments were conducted in a 1 in. × 3 in. supersonic wind tunnel on two-dimensional secondary fluid injection into a uniform primary supersonic stream between Mach 1.64 to 3.08. Primary and secondary fluids were air at the same stagnation temperature, but the secondary stagnation pressure was varied from 0.2 to 2.0 times the primary value; injection was sonic and normal to the primary stream. The shape of the main shock does not correlate in the variables of blast wave theories, but two simple modifications, involving a translation of the virtual origin of the blast upstream of the jet and a replacement of a factor M (the primary Mach number) by $(M^2-1)^{1/2}$, succeed in producing similarity. An expression in the modified variables is fitted to the similarity curve, which tends to a first order blast wave at small distances from the jet and to a Mach wave at large distances. The separation shock in front of the main shock corresponds to a nearly constant flow deflection of about 10°. Interaction force estimates agree with Broadwell's calculation. When compared with wedge or conical nozzles, shock shapes in real rocket nozzles may be appreciably affected by refraction in the main flow. Author

N68-11285# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
A MIXING LENGTH HYPOTHESIS FOR THE TURBULENT BOUNDARY LAYER WITH SUCTION AND INJECTION
W. B. Nicoll and A. B. Strong Nov. 1967 35 p refs
(RR-8) CFSTI: HC $3.00/MF $0.65

The mixing length hypothesis of van Driest is extended to account for the effects of mass transfer. A continuous distribution of momentum eddy diffusivity can now be formulated which accounts for the effects of mass transfer on the hydrodynamic boundary layer and which is valid from the wall to and including the inner law region. This feature is particularly valuable if one attempts to solve for the thermal boundary layer. Comparisons of the theoretical mean velocity profiles based on this hypothesis with blowing data and suction data show that the present model can accurately predict mean velocity profiles for a wide range of mass transfer rates. The theoretical implication of the model with respect to the constants of bilogarithmic laws is examined and shown to be in agreement with the data. Author

N68-11331# California Univ., Berkeley. College of Engineering.
SUPERSONIC SEPARATED FLOW DOWNSTREAM OF A BACKWARD FACING STEP
Donald R. Crawford (Ph.D. Thesis) May 1967 91 p refs
(Grant AF-AFOSR-268-67)
(AS-67-9; AFOSR-67-2592; AD-660111)

The method of integral relations is applied to the study of the viscous separated flow field downstream of a backward facing step in laminar supersonic flow. The boundary layer equations are reduced to a set of coupled ordinary differential equations in a formulation which incorporates a two parameter velocity profile. The neighborhood of the corner and the reattachment point are examined in detail, taking into account the proper interaction between the viscous and inviscid flow. The complete flow field in these regions is found from the analyses of the limiting forms of the equations. In particular, it is found that the pressure gradient and thickness of the boundary layer at the reattachment point are related and cannot be arbitrarily specified. Author (TAB)

N68-11332# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
PERISTALTIC TRANSPORT
Yuan-cheng Fung and Chia-shun Yih Sep. 1967 35 p refs
(Grant AF-AFOSR-1186-67)
(AFOSR-67-2255; AD-660107)

Peristaltic pumping (viscous fluid flow induced by a sinusoidal traveling wave motion of the walls of a tube at moderate amplitudes of motion) is analyzed in the two-dimensional case. It is shown that the non-linear convective acceleration must be considered and that the non-slip condition must be applied on the wavy wall (rather than on the mean position) in order to account for the mean flow induced by the wall motion. In the case in which there is no other course of flow the mean flow induced by the peristaltic motion of the wall is proportional to the square of the amplitude ratio (wave amplitude/half-width of channel). The velocity profile depends on the mean pressure gradient. In this paper only those cases in which the pressure gradient will produce a flow of the same order of magnitude as that induced by the peristaltic motion are considered. If the pressure gradient is positive and equal to a certain critical value, then the velocity is zero on the centerline. Pumping against a positive pressure gradient greater than the critical value would induce a backward flow (reflux) in the core region of the stream. There will be no reflux if the pressure gradient is smaller than the critical value. The velocity profile and the value of the critical pressure gradient are presented. Author (TAB)

N68-11356# General Applied Science Labs. Inc., Westbury, N. Y.
REAL GAS EFFECTS IN A TIME DEPENDENT BLUNT BODY PROGRAM AND CONE AT ANGLE OF ATTACK PROGRAM Final Report, 1 Apr. 1966–31 May 1967

Fred Petri 16 Aug. 1967 17 p refs
(Contract DA-01-021-AMC-14889(Z))
(TR-664; AD-659809)

The report describes the addition of equilibrium air effects to both a time dependent blunt body solution and to a cone at angle of attack solution. The necessary changes of equations and the use of thermodynamic fits are described. Results of sample cases are shown and compared with perfect gas and other equilibrium air calculations. Author (TAB)

N68-11360# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
COMPUTATIONS OF THE NONEQUILIBRIUM FLOW OF A VISCOUS, RADIATING FLUID ABOUT A BLUNT AXISYMMETRIC BODY. VOLUME 2: PROGRAM DETAILS AND OPERATING PROCEDURE Final Report, 30 Jun. 1965–1 Mar. 1967
James T. Curtis and Charles R. Strom Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Jun. 1967 194 p ref
(Contract AF 33(657)-3132)
(CAL-AM-2113-Y-1, V. 2; AFFDL-TR-67-40, V. 2; AD-660105)

The volume presents information necessary for running the program discussed in Volume I. Section 1 contains information on running times, alternative versions of the program, tape requirements and remarks on built-in options. Section 2 gives starting procedure and input format sheets. The output from the program is discussed in Section 3. Possible stops and running difficulties are discussed in Section 4. Subroutines are listed and cross-referenced in Section 5. Section 6 defines the FORTRAN symbols. The volume concludes with flow charts. Author (TAB)

N68-11363# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FLUID TURBULENCE. 1: MATHEMATICAL FOUNDATIONS
N. Tongring Oct. 1967 46 p refs
(R67SD50)

Fluid turbulence is interpreted as a generalized stochastic process. The so-called kinematic part of the classical turbulence theory is developed with this concept, and various kinds of turbulence defined. The necessary mathematical background of functional integration techniques to be used for the solving of a Hopf-type equation for the turbulent field is then presented. Author

N68-11372* Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
FUNDAMENTAL STUDY OF LOW-DENSITY GAS DYNAMICS Semiannual Progress Report, 1 May–1 Nov. 1967
W. M. Milligan, P. W. Cowling, and H. J. Wilkerson 1 Nov. 1967 59 p refs
(Grant NGR-43-001-023)
(NASA-CR-90214; AE-67-023-3) CSCL 20D

The objectives of this study were to investigate rarefied gas flow through annuli with static boundaries and to expand theoretical and experimental capabilities to include flow through annuli with moving boundaries. The emphasis of the study was on shaft sealing applications. Complete theoretical and experimental results for annuli flow with static boundaries are presented in this report. A theoretical model for predicting gas flow through annuli was developed for continuum, slip, and free molecular flow regimes. Experimental measurements were made with two different annuli and two different working gases. Model predictions and experimental data were found to agree. The model is useful for design in the rarefied flow regime. K.W.

N68-11373 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ON THE MERGING OF UNIFORM SHEAR FLOWS AT A TRAILING EDGE
R. J. Hakkinen and Elizabeth J. O'Neil Apr. 1967 51 p refs
(DAC-60862)

The merging of two uniform, infinite, incompressible shear flows downstream of the trailing edge of a semi-infinite flat plate is studied by means of an asymptotic inner–outer expansion procedure applied to the Navier–Stokes equations. The flow field is divided into three regions: an outer flow, where inertia effects dominate and vorticity is primarily convected along streamlines; a wake, where inertia and viscous effects are of the same order and vorticity is diffused across streamlines; and a second-order vorticity-diffusing layer along the plate, generated by the upstream effect of the wake. The expansions appropriate to each region match term by term in the overlap regions; however, coefficients are determined numerically only to the third and fifth orders, in the inner and outer regions, respectively. The results indicate the existence of an induced pressure field. The significance of the present study in relation to the merging of two laminar boundary layers at a trailing edge is evaluated. Author

N68-11385 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATIONS OF THE SPECTRAL DISTRIBUTION OF THE CAVITATION NUCLEI IN WATER
L. R. Gavrilov 13 Jun. 1967 11 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 2, 1966 p 41–42
(FTD-HT-23-510-67; TT-67-63249; AD-660429)

A method of measuring the spectral distribution of cavitation nuclei in liquid in the form of gas bubbles is described and the results of tests for determining the number of nuclei in the water supply line are given. The property of gas bubbles to cause absorption of ultrasonic energy propagating in the medium water gas bubbles was established as a means for measuring the spectral distribution of cavitation nuclei. It was also shown that the basic causes of ultrasonic energy absorption were: (1) the transfer of heat from the bubbles to the liquid during periodic changes in volume under the effect of a sound wave, (2) dissipation of a part of the energy, since a bubble of resonance dimensions becomes itself a spherical emitter of sound. TAB

N68-11452# California Univ., Livermore. Lawrence Radiation Lab.
NUMERICAL SIMULATIONS OF SHOCK TUBES
Barbara K. Crowley 15 Jul. 1967 18 p refs Presented at the Conf. on Mil. Appl. of Blast Simulators, Alberta, Can., 18–21 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-70443; CONF-670712-4) CFSTI: HC $3.00/MF $0.65

The numerical simulation of shock tube flow is considered with the PUFL finite difference calculation which is used to integrate the time-dependent partial differential conservation equations. The results of some PUFL calculations with and without frictional terms are compared with experimental data from the BRL shock tube. The results indicate that the time-dependent solutions are of prime importance in determining the decay of the pressure pulse as it progresses down the tube. They also indicate that significantly better agreement with experimental data is obtained by considering the effects of friction. The agreement of calculational results and experimental data for the width and height of the pressure pulse as it progresses down the tube indicates that the numerical simulation of shock tubes is feasible. Author (NSA)

N68-11483# Michigan Univ., Ann Arbor. Dept. of Engineering Mechanics.
THE STABILITY OF PARALLEL FLOWS OF FLUIDS WITH MEMORIES
Dean T. Mook and W. P. Graebel Sep. 1967 53 p refs
(Contract Nonr-1224(40))
(Rept.-08505-3-T; AD-660374)

The equations governing the stability of plane parallel flows are developed for three models of fluids with memories. Asymptotic solutions valid for large Reynolds numbers are obtained and the effect of the memory are shown to be destabilizing. The approach to the problem allows evaluation of how fast a memory must fade to allow evaluation of the stresses in power series in the time interval. An alternate approach to inverting convected derivatives is also presented. Author (TAB)

N68-11488 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.

COMPRESSIBLE WAKES IN PRESSURE GRADIENTS PART 1: LAMINAR FLOW

S. Vasantha and A. Prabhu Mar. 1967 27 p refs
(AE-270A, Pt. 1) CFSTI: $3.00

This paper gives similar solutions for compressible two-dimensional linearised laminar wake in a pressure gradient. Variation of viscosity with temperature is assumed to be a power law. The Prandtl number is taken as arbitrary. Similarity is found only for a certain class of pressure gradients in the general case. In the usual wake where there is an excess of temperature above the free stream value, similarity exists only for an adverse pressure gradient. Author

N68-11549 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MATHEMATICAL QUESTIONS OF HYDRODYNAMICS OF LIQUIDS WITH FREE BOUNDARIES [MATEMATICHESKIYE VOPROSY GIDRODINAMIKI ZHIDKOSTI SO SVOGODNYMI GRANITSAMI]

Yu. P. Krasovskiy, M. A. Lavrentev, N. N. Moiseyev, A. M. Ter-Krikorov, and A. B. Shabat *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 1–19 refs (See N68-11548 02-34)

The article reviews Soviet publications of the last four years dealing with the theory of the motion of a liquid with free boundaries. New models of free-stream and discontinuous flows are presented and discussed. Approximate methods for investigating wave phenomena, based on the asymptotics of solutions, are reviewed, and exact solutions of problems related to the theory of gravitational waves are analyzed. Attention is directed to the basic problems of the theory of waves, such as those of flows with Froude numbers less than unity in the case of flow past an obstacle, of the theory of waves "in the large," of the theory of three-dimensional flows, and of the complex theory of unsteady waves, for example, periodic (standing) and Cauchy–Poisson waves, for which there is still no rigorous method. Author

N68-11550 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOTION IN LIQUID OF A BODY BOUNDED BY A MULTIPLY CONNECTED SURFACE [O DVIZHENII V ZHIDKOSTI TELA, OGRANICHENNOGO MNOGOSVYAZNOY NOVERKHOST'YU]

P. V. Kharlamov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 21–36 refs (See N68-11548 02-34)

The author treats the problem of finding the motion of a hard body in an ideal fluid, where the body is bounded by a multiply-connected surface such as a torus. He is able, in certain cases, to reduce the problem to one involving a simply-connected bounding surface. Author

N68-11570 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF FLAT AND AXIALLY SYMMETRIC SUPERSONIC CURRENTS IN THE PRESENCE OF IRREVERSIBLE PROCESSES [RASCHET PLOSKIKH I OSESIMMETRICHNYKH SVERKHZVUKOVYKH TECHENIY PRI NALICHII NEOBRATIMYKH PROTSESSOV]

O. N. Katskov and A. N. Krayko *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 171–174 refs (See N68-11548 02-34)

A finite-difference method has been developed to simplify the numerical solution of the equations for one-dimensional and axisymmetrical supersonic flow of an inviscid, non-heat-conducting gas in the presence of irreversible physicochemical processes. The formula was used for calculating the flow of dissociating oxygen in the diverging section of an axisymmetrical nozzle at initial pressure of 1 atm, initial temperature 5000K, and M = 1.001. The results indicate that the presence of irreversible reactions leads to quantitative as well as qualitative changes. The formula can be used for calculating nozzle contours for arbitrary types of flow (subsonic, uniform, unsteady, etc.) in the presence of irreversible processes. Author

N68-11610*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF SELECTED FLUID PARAMETERS ON SPATIAL DROP SIZE DISTRIBUTION

Edward Junior Rice (Ph.D. Thesis—Wis. Univ.) 1966 270 p refs
(NASA-TM-X-52381) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This thesis covers the continuation of work done on a project using a fluorescent technique for the study of the microscopic properties of a fluid spray. This technique enables the examination of the spray properties to be made with extremely fine patial resolution. A cross section of the spray virtually perpendicular to the spray axis and having a volume of 4×4×0.2 mm. can be studied. By movement of the nozzle holding apparatus the cross section of an entire quadrant of the spray can be studied. The distance from the nozzle to this quadrant can also be varied. The extreme spatial resolution is obtained by the use of a high intensity sheet of radiation which intersects the spray at 75 degrees and which has a virtually uniform thickness of 0.2 mm. for the 4 mm. length of sheet covered in the sampling volume. The droplets in this sampling volume absorb radiation from the radiation sheet and emit fluorescent radiation due to the fluorescent dye dissolved in the fluid and thus act as primary radiators. A high resolution camera of 25 magnification and capable of resolving a 10 micron drop with less than 10 percent error is used to photograph the droplets. Author

N68-11631*# Hydronautics, Inc., Laurel, Md.

SUPERCAVITATING CASCADES WITH CONSTANT PRESSURE CAMBERED BLADES

B. Yim Jul. 1967 53 p refs
(Contract NAS8-20625)
(NASA-CR-90426; TR-703-2) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Linearized theory on the flow through a supercavitating cascade with a constant pressure camber is considered, and a simple boundary value problem is solved in the transformed plane with the boundary conditions given on a straight line and at the point which corresponds to negative infinity in the physical plane. Numerical computations were performed on an IBM 1130 computer; and foil and cavity shapes are plotted. Relations between drag coefficients, cavitation numbers, and lift coefficients are plotted for many solidities and stagger angles. The cases of infinite cavity length and of zero solidity are considered, and curvature at leading edges is treated. M.W.R.

N68-11647 Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
IDEAS ON THE PHENOMENON OF REDUCTION INTERVENING IN GAS FLOWS [NOTIONS SUR LES PHENOMENES DE RELAXATION INTERVENANT DANS LES ECOULEMENTS GAZEUX]
Roger Prud'homme Jun. 1967 42 p In FRENCH
(Rept.-67-2) CFSTI: $3.00

The relaxation phenomenon at supersonic flow and enthalpy is elucidated on a glasswork system for ablative materials. The irreversible thermodynamic phenomenon is comprised of several phases: condensation, chemical reactions, ionization, and interspatial molecular motions. The reaction time, the macroscopic mechanism, and the criteria of close equilibrium are approximated. The final phase, the relaxation time responsive to relaxed quasi-unidimensional flow, is presented by two simplified calculations. Transl. by T.Z.D.

N68-11648 Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
STUDY OF THE DISTANT LAMINAR WAKE. 2. ROTATIONAL FLOW [ETUDE DU SILLAGE LAMINAIRE LOINTAIN. 2. ECOULEMENT DE REVOLUTION]
Henri Viviand Jul. 1967 56 p refs In FRENCH
(Rept.-67-7) CFSTI: $3.00

The speed and enthalpy of a remote laminar wake, at rotational symmetry, are expressed as asymptotic functions. Their validity is calculated for a great distance from the point of obstruction. A general formula for the speed and enthalpy is developed in which their first functions are resolved by classical methods and by the Fourier series. The effects of incompressible laminar wake are approximated. Transl. by T.Z.D.

N68-11669 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROPAGATION OF A SHOCK WAVE IN A NONHOMOGENEOUS ATMOSPHERE IN THE DIRECTION OF DIMINISHING DENSITY
Yu. P. Rayzer *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 87–100 refs (See N68-11661 02-23)

A similarity solution is presented for the problem of a plane shock wave propagating through a nonuniform medium of variable density which may be approximated by an exponential function. It is assumed that the shock propagates in the direction of density decrease, though the effect of gravity is neglected. The equation of motion of a shock wave reaching the boundary of the atmosphere $x=-\infty$, $\rho_0=0$ at time $t=0$ is derived. A similarity solution is also considered for the motion of a gas expanding into the vacuum at $t>0$. Numerical calculations were made for the adiabatic exponent $\gamma=1.2$ and $\gamma=5/3$. The distributions of density, pressure and velocity are given in graphs. The solutions obtained are used to describe the flow field in the upper region above an explosion in a nonuniform atmosphere. It is pointed out that in principle the air accelerated upward to a high velocity by the shock wave should escape the earth's gravitational field and "splash" into the vacuum, but that because of strong ionization the upward motion is limited by the retardation effect of the earth's magnetic field. Author

N68-11670 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE NONLINEAR INTERACTION OF A SPHERICAL SHOCK WAVE, ORIGINATING AS A RESULT OF THE EXPLOSION OF A SHAPED CHARGE WITH THE FREE SURFACE OF THE WATER
B. I. Zaslavskiy *In its* J. pf Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 101–114 (See N68-11661 02-23)

Equations of short wave propagation in spherical coordinates are given accompanied by a class of exact special solutions and applied to the case of spherical shock free water surface interactions. Author

N68-11692 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF NORMAL REFLECTION OF SHOCK WAVES IN A SHOCK TUBE
S. G. Zaytsev, Ye. V. Lazareva, and A. P. Shatilov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 282–296 refs (See N68-11661 02-23)

The normal reflection of a shock wave from a solid wall was investigated inside a 72×72 mm shock tube with 4.5 mm low-pressure chamber length and 9 mm high-pressure chamber length. Shift in the interference bands ΔS was determined to within 0.1 band on a Mach–Zender interferometer. The absolute errors in density for nitrogen, carbon dioxide, and argon gases were 0.308×10^{-5}, 0.319×10^{-5}, and 0.462×10^{-5} g/cm^3, respectively. First, the state of the gas behind the incident shock waves was studied in N_2, CO_2, and argon gas for initial pressures of 10, 30, and 100 mm Hg respectively at $2\leq M_s\leq6$. Density measurements were made by means of continuous scanning with a vertical slit. Author

N68-11693 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF RELAXATION ON THE DECAY OF AN ARBITRARY DISCONTINUITY
V. N. Arkhipov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 297–307 refs (See N68-11661 02-23)

The effect of vibrational relaxation in a blast wave before the onset of the secondary shock front was studied analytically. At the shock front equilibrium is assumed for translational and rotational degrees of freedom and behind the shock wave, vibrational equilibrium. The expanding gas is divided into four regions: 1) region between shock wave and surface of contact, 2) region between contact surface and centered rarefaction wave, 3) rarefaction wave, and 4) high-pressure unperturbed gas. Author

N68-11694 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF A POINT EXPLOSION IN VARIOUS GASES
N. S. Mel'nikova and T. M. Salamakhin *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 308–320 refs (See N68-11661 02-23)

An approximate method for the solution of nonsimilar explosion of gases from a point charge in planar, cylindrical, and spherical symmetry was considered for various values of the adiabatic index γ(1.2 to 7). The analysis is based on the hypothesis that at any given time t the density distribution in coordinate space can be expressed as a power law. The equations of motion for an inviscid non-heat conducting gas are written with three boundary conditions on the shock front. Author

N68-11701# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
CORRELATIONS FOR PREDICTING LEAKAGE THROUGH CLOSED VALVES
Jesse Hord 1 Aug. 1967 19 p refs
(NBS-TN-355) GPO: $0.20

Safety, convenience, and economy often demand the inference of leakage of a given fluid from known leakage of another test fluid across valve seats, welded and threaded fittings, seals, etc. The temperatures of the fluids also may be different. An example

is the prediction of gaseous hydrogen leakage at 20°K from test data obtained with nitrogen gas at 77°K. Various flow formulae (molecular, transition, and continuum) are examined, and two simple methods of correlating leakage for single-phase fluids are deduced. The correlations obtained (excluding transition flow through long channels) indicate the leakage is inversely proportional to the square root of the density, or inversely proportional to the absolute viscosity, of the fluid. Thus, for gases, the leakage is directly proportional to the sonic velocity of the gas. The proper relationship must be established by experiment for each valve, fitting, etc. Author

N68-11703 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

THE TURBULENT INCOMPRESSIBLE HYDRODYNAMIC BOUNDARY LAYER

Marcel Paul Escudier (Ph.D. Thesis—London Univ.) Oct. 1967 298 p refs

(TWF/R/6)

The entrainment and kinetic-energy methods for the calculation of turbulent hydrodynamic boundary layers are discussed in detail. The main concern is with the auxiliary relations used by the two methods. Most of the previous proposals for these relations are shown to be deficient in accuracy of prediction, range of applicability and, often, ease of use. New empirical formulae, free from the drawbacks of earlier proposals, are recommended; and predictions of boundary-layer development are presented to demonstrate the adequacy of the new relations. A critical discussion of the predictions leads to the conclusion that, where poor results are obtained, the most likely cause is a lack of two-dimensionality of the mean flow. However, some discrepancies are attributed to failure to comply with other restrictions by which the calculation methods are bound. Author

N68-11735*# Israel Program for Scientific Translations, Ltd., Jerusalem.

FLOW IN CHANNELS WITH PERMEABLE WALLS

I. S. Kochenov, L. I. Baranova, and V. V. Vasil'ev *In its* Heat and Mass Transfer. Vol. 1 1967 p 113–116 refs (See N68-11721 02-33)

Preliminary experiments are described for studying the variable coefficient to the Euler number and its relation to the Reynolds number and the outflow coefficient. The apparatus is briefly described, and the investigations were carried out between Reynolds numbers of 15,000 and 50,000 and outflow coefficients of 8×10^{-4} and 8×10^{-3}. The data indicate that the variable coefficient increases with increasing outflow coefficient and decreases somewhat with increasing Reynolds number. N.E.N.

N68-11753*# Israel Program for Scientific Translations, Ltd., Jerusalem.

UNSTEADY FLOW IN TUBES

I. S. Kochenov and Yu. N. Kuznetsov *In its* Heat and Mass Transfer. Vol. 1 1967 p 266–273 refs (See N68-11721 02-33)

Flow equations for the unsteady flow of fluids in circular rigid tubes of constant cross section are analyzed. Pressure drop components consisting of the inertial drop, the friction drop, and the drop caused by the rearrangement of the velocity profile, are considered. Two solutions for prescribed conditions of flow are written in terms of dimensionless numbers and worked out into equations for calculating the referred coefficient of friction. Experimental studies using water and oil as the working media were conducted to check out calculations of the equivalent unsteady friction resistance coefficient in turbuelnt flows. Results indicate that the values of the equivalent coefficient depends both on the first and the second logarithmic derivatives of the flow rate with respect to time. In addition, experiments on the local resistance to unsteady flow were carried out, and values of the equivalent unsteady friction resistance coefficient were obtained which differ markedly from unity. The studies show that the value of the hydraulic friction resistance coefficient under well-defined unsteady flow conditions differs markedly from the quasisteady value, and that this difference must be accounted for in the calculation processes which change rapidly with time. Author

N68-11763# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.

EXPERIMENTS ON TURBULENT BOUNDARY LAYERS ALONG A CIRCULAR CYLINDER WITH AND WITHOUT SEPARATION

Hans Fernholz and Paul Gibson Jul. 1967 23 p refs

(Contract Nonr-1841(91))

(Rept.-91; AD-660017)

Experiments were conducted in a turbulent boundary layer near separation along a circular cylinder with the flow in the axial direction. The pressure gradient along the axis of the cylinder could be varied such that it was possible to maintain three boundary-layer configurations close to separation or with regions of reversed flow: (1) A turbulent boundary layer with skin friction zero; (2) A turbulent boundary layer with a separated region and reattachment further downstream with skin friction zero; (3) A turbulent boundary layer with a region of small but constant skin friction and normal separation. Pressure and skin friction along the cylinder wall, as well as mean velocity profiles in the boundary layer, were measured. Author (TAB)

N68-11807# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

COMPARISON OF INCOMPRESSIBLE FLOW AND ISOTHERMAL COMPRESSIBLE FLOW FORMULAE

Jesse Hord 17 Aug. 1967 30 p refs

(NBS-TN-356) GPO: $0.25

Mass flow formulas for incompressible and modified-incompressible flow are compared with the isothermal compressible flow relation under the following conditions: The gas flow is steady, isothermal, and fully developed in a horizontal pipe of constant cross section with a prescribed static pressure drop (P_1–P_2). The comparative data are limited to static pressure ratios $(P_2/P_1)>1/2$, and subsonic isothermal flow. Laminar and turbulent flows are treated. Under the limitations of the comparison, modified-incompressible flow and isothermal gas flow relations are identical when $fL/2D>>/n(P_1/P_2)$. Graphical plots indicate the degree of approximation or error involved in using incompressible relations to solve compressible flow problems. Pressure losses due to end effects are briefly discussed. Author

N68-11890 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

TWO-DIMENSIONAL FLOW OF A VISCOUS INCOMPRESSIBLE FLUID AROUND A BODY EXTENDING INDEFINITELY DOWNSTREAM [ECOULEMENT PLAN D'UN FLUIDE VISQUEUX AUTOUR D'UN OBSTACLE S'ETENDANT A L'IN'FINI AVAL]

Robert Legendre 1967 17 p refs In FRENCH; ENGLISH summary Presented at the AGARD Seminar, Teddington (England), 18–21 Sep. 1967

(ONERA-TP-505(1967)) CFSTI: $3.00

Three methods for the solution of the Navier–Stokes equations for the flow of an incompressible viscous fluid are proposed. The first is applicable to boundary layer studies. The second is mainly adapted to the study of flow around a paraboloid. The third is much simpler than the two previously cited methods; however its

mathematical basis is not as good, and it is more convenient for an improvement of the usual boundary layer study than for a really valid discussion of the conventional hypotheses. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-11009# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

INVESTIGATIONS OF THE CONSTANT GEOMAGNETIC FIELD (ALL-UNION CONFERENCE IN LENINGRAD) [ISSLEDOVANIYA POSTOYANNOGO GEOMAGNITNOGO POLYA–VSESOYUZNAYA KONFERENTSIYA V LENINGRADE]

S. Yu. Brodskaya Sep. 1967 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 2, 1967 p 93–94
(ACIC-TC-1252; TT-67-63055; AD-659644)

The VII Regular All-Union Conference on the Constant Geomagnetic Field and Paleomagnetism took place in Leningrad on November 18-27, 1966. About 400 participants were registered, among them representatives of the Academies of Sciences of the Socialists States. A total of 110 reports were made on recent achievements in three scientific fields of terrestrial magnetism: on the magnetic field of the earth, on paleomagnetism and on rock magnetism. Attempts were made to link the data of experimental studies on the constant geomagnetic field with theoretical concepts; certain works were dedicated to studies of the earths magnetic field in outer space and to studies of the lunar magnetic field; magnetic measurements taken in the Norwegian Sea by a non-magnetic schooner commanded much attention; magnetic mapping and instrumental problems were the concern of several reports; all data presented on paleomagnetism were confirmed by laboratory experiments. Problems connected with the studies of rock magnetism occupied a considerable part of the conference program. Methods of separating initial magnetization and determining its nature and connections with the mineralological rock composition and physical-chemical conditions should be improved. This is the basic problem which the conference drew to the attention of the scientists. The next conference will take place in Kiev in 1970. TAB

N68-11011* St. Louis Univ., Mo. Dept. of Geophysics and Geophysical Engineering.

STRUCTURE AND CIRCULATION OF THE LOWER MARTIAN TROPOSPHERE: SUBSOLAR-MERIDIAN MEAN-ANNUAL DISTRIBUTIONS BELOW 50 KILOMETERS Preliminary Report

F. C. Bates 22 May 1967 62 p refs
(Grant NGR-26-006-016)
(NASA-CR-90225) CSCL 04A

Available observations of the Martian atmosphere were employed to estimate the composition of the homogeneous atmosphere and equivalent-mean-sea-level pressure (100% CO_2 and 7.0 millibars). A mean-annual subsolar-meridian distribution of temperature, pressure, and zonal-wind speed was then constructed for a depth of 50 km based on the foregoing estimates and: (1) wave regime; (2) hydrostatic balance; (3) midlatitude scale height consistent with Mariner IV observation; (4) tropopause height varying from 30 km at the equator to 10 km at the pole; (5) mean jet-stream position at 45° latitude and 20 km; and (6) estimates from similarity to Earth and other rotating-fluid systems. The foregoing and its bases were then extended to an estimate of wind and wind regimes, including secondary circulations such as extra-tropical cyclones and yellow-dust devils. Computations of heating rates in a ten-layer model were used to test soundings at several latitudes to determine required dynamic and/or advective compensation. Author

N68-11057 Royal Aircraft Establishment, Farnborough (England).

AN ATTEMPT TO CALCULATE THE COEFFICIENT OF TURBULENCE FROM TEMPERATURE–WIND SOUNDING

M. P. Churinova Aug. 1967 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 63, 1956 p 168–172
(RAE-LIB-TRANS-1243)

This report demonstrates the use of a new formula derived by Laikhtman to enable the coefficient of turbulence K, to be calculated from temperature and wind soundings. Examples are given to enable a comparison to be made with an earlier formula. Author

N68-11063 Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Dept. of National Development.

UPPER CRETACEOUS AMMONITES FROM THE CARNARVON BASIN OF WESTERN AUSTRALIA. I: THE HETEROMORPH LYTOCERATINA

R. O. Brunnschweiler 1 Aug. 1966 73 p refs *Its* Bull. No. 58
CFSTI: $3.00

This bulletin deals with the Heteromorph Lytoceratina of Santon–Campanian and Maastrichtian age. It is proposed to subdivide the Heteromorph Lytoceratina further by removing a number of genera from Turrilitacea to form a new superfamily Diplomoceratacea. It is shown that Diplomoceratacea are derived from Cicatritidae, whereas Turrilitacea stem from Macroscaphitidae. Diplomoceratacea are represented in Western Australia by the genera *Hyphantoceras* Hyatt, *Diplomoceras* Spath, *Bostrychoceras* Hyatt, and *Eudiplomoceras* nov.; Turrilitacea by *Baculites* Lamarck, *Eubaculites* Spath, *Giralites* nov., *Eubaculiceras* nov., *Cardabites* nov., *Nostoceras* Hyatt, *Glyptoxoceras* Spath, and *Neohamites* nov. Scaphitacea are represented by a single specimen of a new species of *Indoscaphites* Spath. Thirty species of the above 13 genera are described, 17 of which are new. Author

N68-11140# Florida Atlantic Univ., Boca Raton. Geography Dept.

WAVEFORM ANALYSIS OF GEOGRAPHIC PATTERNS RECORDED ON VISIBLE AND INFRARED IMAGERY

Richard E. Witmer Sep. 1967 240 p refs
(Contract Nonr-4761(00))
(TR-4; AD-660174)

The primary objectives of this study were: (1) the application and refinement of an electronic technique for scanning visible and infrared imagery; and (2) the development of a methodology which would discriminate between various terrain types recorded on such imagery. Two multispectral imagery sets were used, a panchromatic-thermal infrared set and three frames of a nine-lens multiband camera set. Video conversion techniques concerning consistent display, imagery orientation, and scan-line selection were developed and applied to all images. After the waveforms were reproduced on a sampling grid, waveform segments associated with specific terrain types were isolated and several statistical variables were calculated. Using combinations of these variables, it was possible to isolate and differentiate between the terrain types recorded. Additional testing removed several sources of statistical error, thereby improving the accuracy of the waveform measurement. Author (TAB)

N68-11166# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

THE SOURCE OF ATMOSPHERIC ELECTRIFICATION

Willis L. Webb Jun. 1967 61 p refs

(ECOM-5139; AD-660316)

Synoptic rocket exploration of the stratospheric circulation has revealed the presence of hemispheric tidal circulations which are indicated to be in part characterized by systematic vertical motions in low latitudes of the sunlit hemisphere. These vertical motions are powered by meridional oscillations in the stratospheric circulation produced by solar heating of the stratopause region, and serve as the energy source of electrical current systems which are postulated to result from an impressed electromotive force which is produced by charged particle mobility differences in the lower ionosphere as the tidal circulations tend to force these particles across the earths magnetic field. These dynamo currents are variable with geometry and time variabilities of the tidal circulations as well as variability in the solar-induced conductivity of the E region. The semiconducting lower atmosphere and highly conducting earths surface occupy the near field of the lower side of this current system with a resulting complex tropospheric electrical structure. Low impedance electric current paths along magnetic field lines result in development of currents in the exosphere which are driven and controlled by the electrical structure of the primary dynamo circuit and exert a control of their own through interaction with the solar wind. Author (TAB)

N68-11181# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF RADIATIVE HEAT EXCHANGE IN THE SURFACE LAYERS ABOVE SEAS AND OCEANS [EKSPERIMENTAL'NYYE I TEORETICHESKIYE ISSLEDOVANIYA RADIATSIONNOGO TEPLOOBMENA V PRIZEMNOM SLOYE NAD MORYAMI I OKEANAMI]

V. S. Samoylenko 28 Apr. 1967 47 p refs Transl. into ENGLISH from Tr. Inst. Okeanol. Akad. Nauk SSSR, v. 78, 1965 p 128–153

(Contract AF 33(657)-16408)

(FTD-HT-67-415; TT-67-63236; AD-660407)

It is the purpose of the present paper to familiarize the reader with certain results of experimental measurements of the radiation balance and atmospheric emission at various altitudes above sea level, these measurements having been carried out in the Black Sea in 1961 and 1962. These measurements were undertaken to verify preliminary theoretical calculations based on the prevailing scientific conceptions of the emittance and absorptance of the basic substances within the composition of atmospheric air above seas and oceans. With regard to water vapor, this test was extremely necessary, since the contentions on which the calculations of the balance of the longwave infrared emission of the earth and of the atmosphere are based have been taken up to the present time primarily from laboratory rather than from natural studies. However, the natural investigations of these water-vapor absorption spectra in the region of atmospheric emission are carried out extremely infrequently because of the complexity involved. It is for this reason that the numerical values of the absorption coefficients derived from the laboratory studies are not sufficiently accurate. Author (TAB)

N68-11186# Illinois Univ., Urbana. Electrical Engineering Research Lab.

IONOSPHERIC RESEARCH Quarterly Progress Report, Apr. 1–Jun. 30, 1967

H. D. Webb Ft. Monmouth, N. J. Army Electron. Command Jun. 1967 39 p refs

(Contract DA-36-039-AMC-03703(E))

(QPR-15; AD-660320)

Moon reflected signals were received at 150.6 MHz and 413.25 MHz on 35 days for 330 and 64 hours of operation, respectively. The operational times are summarized in tabular and in graphical form, solid state servo amplifiers using SCR's are in operation for both azimuthal and elevation control. Circuit diagrams and brief descriptions of operation are given. Uncertainties in some of the 413.25 MHz data for 1966 are being resolved using ionograms. Some topside to bottomside ratios for 1965 data have been calculated. Signals from ATS-1 were recorded from 1120 CST May 21 to 0210 CST May 28. This period included several major solar flares and a severe magnetic storm May 25–27. The electron content data for May 21 and May 23 are presented. At the time of the flare on May 21 there was an increase of 1.6×10 to the 16th power electrons per square meter in 5 minutes. On May 23, at the time of the flare there was an increase of 3.2×10 to the 16th power electrons per square meter in 15 minutes. Data showing unusual effects during the magnetic storm May 25 are withheld, pending further study. Author (TAB)

N68-11247*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COMPRESSION OF THE PLASMASPHERE DURING GEOMAGNETICALLY DISTURBED PERIODS

H. A. Taylor, Jr., H. C. Brinton, and M. W. Pharo, III Nov. 1967 31 p refs

(NASA-TM-X-63033; X-621-67-559) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Evidence of the behavior of the plasmasphere during the important solar flare events of July 7, 1966 and July 9, 1966 are presented and results are compared to both earlier storm time data obtained from OGO's I and III, and related whistler observations of the plasmapause. Positive ion spectrometer results from OGO III during June to July 1966 provided profiles of H^+ and He^+ to altitudes as great as 40,000 kilometers in the magnetosphere, where L=8. Results indicated that (1) within the plasmasphere the H^+ profiles fall off rather smoothly with altitude and L, from concentrations of the order of 10^4 ions/cm^3 near L=2; (2) at the outer edge of the plasmasphere, the H^+ concentrations decrease very rapidly to concentrations of 5×10^2 ions/cm^3 or less; and (3) the He^+ profiles closely parallel the H^+ profiles at a concentration typically lower by a factor of nearly 100. The location of the plasmapause crossings observed near midnight local time was found to vary with magnetic activity, with an inverse correlation between the L coordinate of the plasmapause and the maximum value of K_p in the 24 hours preceding the event. These results, compared with whistler measurements of the plasmapause indicate large scale expansion and contraction of the plasmasphere relative to specific magnetic storms. Associated with solar flare events occurring on July 7 to 9, 1966 and June 15, 1955, the plasmasphere was observed to be displaced inward to L positions as low as L=3.3, following $K_p\geq5$, in contrast to quiet magnetic conditions when the plasmasphere expands to L=6 or higher. S.C.W.

N68-11248# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.

INELASTICITY OF CRYSTALLINE ROCK AT HIGH PRESSURE: APPLICATION TO TIDAL FRICTION AND SEISMOLOGY

R. B. Gordon Oct. 1967 17 p refs

(Contract Nonr-609(54))

(TR-4; AD-659988)

The inelastic response of igneous and metamorphic rocks to alternating stress has been measured at low frequency under hydrostatic confining pressure. The inelasticity is characterized by an internal friction and modulus defect that are quite pressure sensitive. It is shown from the laboratory data that no significant contributions to the observed tidal friction is expected from the solid earth and that particle melting will result in a low velocity, low Q zone in the mantle. Author (TAB)

N68-11255 Chubu Inst. of Tech., Kasugai (Japan).
THE DEVELOPMENTS OF THE STUDY ON WHISTLERS AND ATMOSPHERICS IN JAPAN FOR THE LAST 40 YEARS
A. Kimpara [1967] 12 p Presented at Comm. 9 of IUGG Gen. Assembly, St. Gallen, Switz., 28 Sep. 1967

Consideration is given to the nature of atmospherics; atmospherics and meteorology; the statistical characteristics of atmospherics; and whistlers, elf, and vlf noise phenomena in a review of study developments generally concerned with natural electromagnetic noise phenomena. The discussion takes into account such topics as measuring apparatus, atmospheric waveforms, atmospheric intensities, frequency spectrums, and measurements of long and short term variations. C.T.C.

N68-11263# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
CALCULATING THE AMOUNT OF UNFROZEN WATER IN FROZEN GROUND FROM MOISTURE CHARACTERISTIC CURVES
R. Keune and P. Hoekstra Jul. 1967 13 p refs
(CRREL-SR-114; AD-659781)

The unfrozen water content of a soil can be determined by calculating the partial molar free energy of water (delta F bar, subscript l) at any temperature and referring this value to the plot of delta F bar, subscript l vs. the water content of the soil under consideration. A plot of delta F bar, subscript l vs. water content can be obtained from a moisture characteristic curve at room temperature. Methods of calculating the numerical values for the graphs are outlined. Data are given for granular, clay, loam, and peat soils and for Na-montmorillonite, so that the results should be useful in estimating unfrozen water by comparing an unknown soil with a similar soil in the report. Author (TAB)

N68-11274# Clark (G. B.) and Associates, Rolla, Mo.
A COMPARSION OF PLANE AND SPHERICAL TRANSIENT VOIGT WAVES WITH EXPLOSION GENERATED WAVES IN ROCK MASSES Final Report
G. B. Clark, G. B. Rupert, and J. E. Jamison Apr. 1967 105 p refs
(Contract DA-22-079-ENG-464)
(Rept.-1-170; AD-660340)

Plane and spherical waves in a Voigt medium were investigated to compare the calculated wave forms with observed waves generated by large contained HE and NE explosions. Interest is centered on wave forms in what is usually considered to be the elastic region around an explosion. Plane waves do not apply at this distance because of geometry. The plane Voigt wave equation has been previously solved for particle velocity, stress and strain for a unit impulse forcing function. However, solutions for the displacement for a unit impulse and for the four wave parameters for a unit step and a decay exponential involve multipliers in the operational form for which no transform pairs have been published. A method of solution is presented which utilizes a Heaviside expansion of the multipliers in the transform plane which results in products of two infinite series which may be inverted term by term. These may be further resolved as single series with polynomial coefficients for purposes of computation. A similar method of solution of Voigt spherical waves was found for unit impulse, unit step and decay exponential forcing functions for displacement, particle velocity, strain and radial stress. Appropriate recursion formulas make them readily adaptable to computer evaluation. Oscillations occur for a spherical wave whereas for a plane wave they do not. Calculations were performed for particle velocity for three values of the Voigt viscoelastic parameter and comparisons made with pulse forms for waves in granite, tuff and salt. Author (TAB)

N68-11298# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
A STUDY OF HEXAGONAL AND CUBIC ICE AT LOW TEMPERATURES
Motoi Kumai Jul. 1967 24 p refs
(CRREL-RR-231; AD-660323)

The formation of hexagonal and cubic forms of ice was studied by the use of a cold stage in an electron microscope within the temperature range of -190 to 170 degrees C. Ice crystal specimens were made on cold substrates, i.e., a collodion film, gold foil, or copper grid on the specimen holder of the cold stage. The structural forms of the ice were detected with the electron microscope using the selected area electron diffraction method. The hexagonal form of ice formed on the cold substrates at temperatures from -90 to -100 C. At -100 to -130 C, both hexagonal and cubic forms of ice were detected. From -130 to -160 C only cubic ice was found. At temperatures below -170 C, minute crystals of cubic ice were detected. No transformation of the structural form of ice from hexagonal to cubic or from cubic to hexagonal occurred when the temperature of the specimens was varied in the range of -90 to -160 C. The minute crystals of cubic ice formed below -160 C were transformed into larger cubic ice crystals by heating them to a temperature between -130 and -150 C. The lattice constants of hexagonal and cubic ice, and the coefficient of thermal expansion of ice were calculated from the experimental results. Author (TAB)

N68-11338*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
STUDY OF ABRASIVE TECHNIQUES FOR LUNAR AND PLANETARY SOLID ROCK GEOLOGICAL SAMPLING
Philip Blum and M. J. Hordon Aug. 1967 37 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951422)
(NASA-CR-90328) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Abrasive techniques were experimentally studied at atmospheric pressure for producing rock powders suitable for automated lunar and planetary geological analysis. Diamond grinding wheels and tungsten carbide milling cutters were employed on fine grained basalt, without a coolant, utilizing a surface grinder. A vacuum chamber was designed for conducting intended future grinding experiments at about 10^{-4} Torr. Grinding by simple vertical penetration was found feasible for producing, without auxiliary sorting, particle sizes suitable for X-ray diffractometry. This method utilized a grinding cam to maintain a fixed grinding contact area. Particle sizes were altered by changing grit size and wheel speed, e.g., powder weight in the generally desirable 0–20π range was varied from 32% to 65% by changing grit size from 60 to 100, respectively, while maintaining wheel speed at 400 rpm. Wheel wear was small, less than 0.3% of the powder weight. A metallic binder was found to be the optimum wheel bonding agent. Abrasive techniques other than vertical grinding and conventional traverse grinding were investigated. Through a method of grinding parallel ridges and subsequently milling them, considerably greater control was effected; ridge height and width were the primary new controlling parameters. The method produced 17% of the powder weight between 74 and 150μ, and 71% between 44 and 420μ. Automating this method for securing both X-ray and microscopic specimens is discussed. Author

N68-11366 National Environmental Satellite Center, Washington, D. C.
ATLAS OF WORLD MAPS OF LONG-WAVE RADIATION AND ALBEDO FOR SEASONS AND MONTHS BASED ON MEASUREMENTS FROM TIROS 4 AND TIROS 7
Jay S. Winston and V. Ray Taylor Sep. 1967 35 p refs
(NESC-43)

Monthly and seasonal global charts are presented for the periods February–June 1962 (TIROS IV) and July 1963–May 1964 (TIROS VII). Monthly average 700-mB height and geostrophic wind charts for the Northern Hemisphere are shown for comparison with radiation data. Also given are difference maps for corresponding months of different years. Derivation of the data and the format in which the data are presented are discussed. Author

N68-11377*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
RARE GAS EVIDENCE FOR TWO PAIRED METEORITE FALLS
Dieter Heymann May 1965 18 p refs Submitted for publication
(Grant NsG-355; Contract AT(11-1)-382)
(NASA-CR-90216; EFINS-64-53; COO-382-56) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Rare gas contents were determined by mass-spectrometry in meteorites of two so-called paired falls: Accalana–Artracoona–Carraweena and La Lande–Melrose–Taiban. The results show that Accalana and Carraweena are identical, whereas Artracoona appears to be an independent fall. The "La Lande" group includes at least one independent fall: Taiban. A comparison of terrestrial meteorite ages to meteorite fall frequencies show that the survival of coincidences of octahedrites and ordinary chondrites is quite likely. Author

N68-11378# GCA Technology Div., GCA Corp., Bedford, Mass.
A METHOD FOR FITTING LINEARLY SEGMENTED MULTI-LAYER ATMOSPHERIC MODELS TO AN ARBITRARY SET OF UPPER AND LOWER BOUNDARY CONDITIONS
R. A. Minzner Mar. 1967 27 p ref Sponsored by DASA
(Contract AF 19(628)-6085)
(GCA-TR-67-6-A; AFCRL-67-0198; SR-4; AD-653203)

Any set of temperature, pressure, and density values which is realistic for one altitude can be exactly connected to another set of temperature, pressure and density values at a second altitude with a model atmosphere defined by the appropriate linearly segmented two-layer temperature–altitude profile provided one of these layers is isothermal and the second is a nonzero constant gradient of temperature with respect to height. The altitude comprising the intersection of the two segments of the required temperature–altitude profile is determined mathematically. The method for generating two-layer models is applied to the generation of three-layer and four-layer models. Author

N68-11388# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
SHOCK TRANSMISSION THROUGH ICE AND SNOW Final Report
Charles E. Joachim Sep. 1967 101 p refs
(TR-1-794; AD-659774)

During the summer of 1963, twenty-six 32-pound and twenty-one 10-pound spherical TNT charges were detonated at depths varying from 9.5 feet below to 9.5 feet above the snow surface near Camp Century on the Greenland Ice Cap. Airblast pressure-time measurements were made to determine pressure loadings on the snow surface, and acceleration-time measurements were made to determine near-surface snow motion, particularly the late-arriving motion. Detonation of multiple shots on the same gage array caused compaction of the near-surface snow. The increase in snow density resulted in higher amplitude motions on succeeding shots. The shock wave generated by an explosive source at or above the snow surface attenuates very rapidly to a depth of 5 feet. Peak vertical downward accelerations from gages at a 2.0-foot depth of burial are three to four times greater than accelerations from gages at a 5.0-foot depth. Below a 5.0-foot depth the data indicate a much smaller decrease of peak vertical downward acceleration with depth. A typical acceleration-time history shows the airblast-induced motion arriving first, followed by the refracted airblast-induced shock. After passage of these waves comes a relatively long-duration (20-60 msec) downward acceleration of approximately 1 g, followed by a bottoming action or an abrupt apparent upward acceleration, i.e. the abrupt coming to rest of the accelerometer. TAB

N68-11414* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
SIMULTANEOUS DUST AND OZONE SOUNDINGS OVER NORTH AND CENTRAL AMERICA
James M. Rosen Aug. 1967 239 p refs
(Grant NsG-281)
(NASA-CR-90427; AP-25) CSCL 04A

Simultaneous soundings of ozone and sub-micron dust over North and Central America are reported. The results show considerably more dust in the equatorial stratosphere than in the middle latitude stratosphere. The relative maximum in the dust concentration observed near the level of the tropical tropopause and as far north as 60° is attributed to an equatorial dust source. The occasional appearance of a secondary dust maximum immediately above the mid-latitude tropopause is attributed to a form of transport other than that of eddy diffusion. The structure in the ozone and dust profiles appears to be highly correlated in the lower mid-latitude stratosphere. A quantitative model is presented describing the production and transport of dust in the stratosphere. Author

N68-11427# Kansas Univ., Lawrence. Dept. of Geography.
VIEWING POINTS FOR THREE-DIMENSIONAL MAPS
George F. Jenks and Paul V. Crawford Sep. 1967 29 p refs
(Contract Nonr-583(15))
(TR-3; AD-660039)

The report sets forth a series of guidelines for selecting viewing points for three-dimensional maps. These guidelines are based upon the need for clarity, realism, and aesthetic quality in map representation. The report contains 20 illustrations which show the various aspects of azimuthal and elevational positions of the viewing point. One illustration contains 96 views of the hypothetical surface used in the analysis. Author (TAB)

N68-11446# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Dept. of National Development.
GEOLOGY OF BOUGAINVILLE AND BUKA ISLANDS, NEW GUINEA
D. H. Blake and Y. Miezitis 1967 78 p refs *Its* Bull. No. 93
CFSTI: HC $3.00/MF $0.65

A geological survey of Bougainville and Buka, the northermost islands of the Solomon Islands, was conducted to determine the geological setting of the gold and copper mineralization. Some information on the islands' access, population, industry, climate, flora and fauna, previous investigations, topography, drainage, and topographical names and heights is briefly discussed. The main discussion covers the islands' stratigraphy, intrusive rocks, igneous petrography, metamorphism, structure, geological history, and economic geology. R.N.A.

N68-11457 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY AND SPACE NUMBER 169
5 Dec. 1967 204 p Transl. into ENGLISH from Russian Publ.
(JPRS-43576; TT-61-11147-169) CFSTI: $3.00

Abstracted data from recent publications are presented in the general areas of astronomy, meteorology, oceanography, terrestrial

geophysics, upper atmosphere and space research, and offshore well drilling. N.E.N.

N68-11496# Harvard Univ., Cambridge, Mass. Dept. of City and Regional Planning.
PROPOSED SOLUTION FOR THE MINIMUM PATH PROBLEM
C. Ernesto S. Lindgren 14 Oct. 1967 30 p *Its* Theoret. Geography Paper No. 4
(Contract N00014-67-A-0298)
(TR-4; AD-660193)

The paper presents a geometrical analysis and graphical portrayal of the problem of determining the minimum path between any two points, being given the minimum paths from two other points, to all points on the respective surfaces. Author (TAB)

N68-11572 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE THEORY OF PROBABILITY PROCESSES IN WATER POWER [O PRIMENINII TEORII VEROYATNOSTNYKH PROTSESSOV V GIDROENERGETIKE]
N. A. Kartvelishvili *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 179–193 refs (See N68-11548 02-34)

This article discusses probability and deterministic conceptions in the theory of adjustment of river drain. The possibilities of the calendar method are discussed. There are also listed objections to application of the theory of random processes. River drain is studied as a random process and some accidental factors are described. Conditions of the energy system are considered as stochastic process. Author

N68-11589* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROCKET MEASUREMENTS OF THE E-REGION ELECTRON DENSITY DISTRIBUTION IN THE VICINITY OF THE GEOMAGNETIC EQUATOR
A. C. Aikin and L. J. Blumle Oct. 1967 24 p refs
(NASA-TM-X-55973; X-615-67-498) CSCL 04A

Six Nike–Apache rockets were instrumented and launched in March 1965 to obtain electron density profiles of the E region in the vicinity of the geomagnetic equator near the coast of Peru. Four of the flight, which occurred around local noon, exhibited little variation; and no sporadic E layer was observed, although a q-type sporadic E was visible on the ionograms taken simultaneously with the flights. The two flights conducted at night showed extreme variability at 150 km, with values of 2×10^3 cm^{-3} and 4×10^4 cm^{-3} obtained at 200 km for the two flights. In order to explain this difference, it is suggested that either on certain nights or after midnight the E region above 150 km is under F region control. A downward drift was also found at night. Analysis of the electron saturation current of the Langmuir probe included as part of the rocket payload resulted in a saturation current to electron density ratio of 10^{-10} amp cm^3, although significant altitude variations are found. M.W.R.

N68-11591*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE SCALAR MAGNETIC INTENSITY AT 1100 KILOMETERS IN MIDDLE AND LOW LATITUDES
A. J. Zmuda, W. E. Radford, F. T. Heuring, and P. Verzariu Sep. 1967 28 p refs
(NASA Order R-21-009-004; Contract NOw-62-0604-c)
(NASA-CR-90522) CFSTI: $3.00/MF $0.65 CSCL 04A

With a Varian Rb-85 magnetometer, satellite 1964 83C measured the scalar magnetic intensity in middle and low latitudes at about 1100 km altitude. The differences between observed and computed values show quasi-sinusoidal spatial variations indicative of errors in the harmonic coefficients with $n\approx3$, $m\approx4$, and $m\approx6$. The isodynamic lines in the South Atlantic anomaly form closed loops around a center at 20°S and 45°W. In the recovery phase of the storm of 1312 UT April 17, 1965, a decrease in intensity occurs which is comparable to the decrease at the earth's surface. Author

N68-11613* State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE DEVELOPMENT OF THE FORBUSH DECREASE AND THE GEOMAGNETIC STORM FIELDS
S. Yoshida (Alaska Univ.) and S.-I. Akasofu Dec. 1965 23 p refs
(Grants NsG-201-62; NsG-233-62)
(NASA-CR-90497; Rept.-65-41) CFSTI: $3.00 CSCL 04A

Relationships between the development of Forbush decreases and characteristics of associated geomagnetic storm fields are examined. It is shown that the onset of a significant Forbush decrease is more closely related to the development of successive sudden impulses of world-wide geomagnetic micropulsations during geomagnetic storms than to a simple step function-like storm sudden commencement. The magnitude of the main phase decrease shows no obvious relation with the magnitude of the Forbush decrease. Author

N68-11622# Aktiebolaget Atomenergi, Stockholm (Sweden).
AN INVESTIGATION OF TRACE ELEMENTS IN MARINE AND LACUSTRINE DEPOSITS BY MEANS OF A NEUTRON ACTIVATION METHOD
O. Landstroem, K. Samsahl, and C-G. Wenner Oct. 1967 32 p refs
(AE-296) CFSTI: HC $3.00/MF $0.65

A neutron activation method for multi-elemental analysis was applied to argillaceous deposits from the Viskan Valley on the Swedish West Coast, an area in which transgressions and regressions of the sea have occurred during the postglacial time. The changes between fresh-water and marine stages are well known from earlier geologic investigations. Analysis could therefore be performed of samples of known marine (brackish) and lacustrine origin. In a preliminary test on four samples, taken from two marine layers and two lacustrine layers, altogether 30 elements were quantitatively determined, namely As, Br, Ca, Ce, Co, Cr, Cs, Eu, Fe, Ga, Hf, Hg, La, Lu, Mn, Na, Rb, Sb, Sc, Se, Sm, Sr, Ta, Tb, Th, U, W, Yb, Zn and Zr. Several elements showed a difference in concentration between the marine and the fresh-water layers. Br, Hg, Mn, Se, As and Sb were more thoroughly investigated in three boreholes from different sections of the valley. Br and Se had high means in the most pronounced marine samples of the fiord deposits. Moreover, Mn showed a fourfold increase just in the transition stage between the older sea fiord and the older lage stage. Author

N68-11714* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGIC APPLICATIONS OF ORBITAL PHOTOGRAPHY
Paul D. Lowman, Jr. Washington Dec. 1967 42 p refs
(NASA-TN-D-4155) CFSTI: HC $3.00 CSCL 08G

The potential geologic applications of orbital photography (photography of the surface of the earth or similar bodies from orbiting spacecraft) with illustrations from various Gemini flights are summarized. Advantages of orbital over conventional aerial photography include: large area per photograph, rapid coverage, rapid repetition of coverage, world-wide coverage (subject to orbital parameters), absence of restrictions on dissemination of American photographs, availability of color at small added cost, and a wide range of scales. The major limitations of orbital photography include: restriction by orbital characteristics (inclination to equator,

apogee, and perigee), the generally high global cloud cover, daylight restrictions, atmospheric scattering, resolution limit inherent in extremely small scales, loss of resolution and color fidelity in oblique photos, site acquisition, and degradation of film by radiation and other space environmental conditions. Three major geologic uses of orbital photography can be predicted: regional geologic mapping, monitoring of variable properties and geological education. Author

N68-11768# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

DENSITY, TEMPERATURE AND THE UNCONFINED COMPRESSIVE STRENGTH OF POLAR SNOW

Austin Kovacs Jul. 1967 32 p refs

(CRREL-SR-115; AD-660309)

The relationships between several empirical and theoretical methods of determining the unconfined compressive strength of polar snow from depth-density and temperature profiles are discussed and graphically compared. Two unconfined compressive strength equations are proposed for snow at -10 degrees C. The formulas take into consideration the decided changes in slope of the Youngs and shear modulus curves at a density of 0.5 g/cm3 for Greenland snow. The slope changes signify that at this density a structural and, therefore, a strength change occur. Analysis of existing test data confirms this reasoning. Author (TAB)

N68-11819* Chicago Univ., Ill. Enrico Fermi Inst.

RADIATION AGES AND GAS-RETENTION AGES OF CARBONACEOUS CHONDRITES AND OF UNEQUILIBRATED ORDINARY CHONDRITES

D. Heymann and E. Mazor 1967 116 p refs Presented at Symp. on Radioact. Dating and Methods of Low-level Counting, Monaco, 2–10 Mar. 1967

(Grant NSG-366)

(NASA-CR-90538; SM-87/44) CFSTI: HC $3.00 CSCL 08G

He, Ne, and Ar have been determined by mass-spectrometry in 25 carbonaceous chondrites, and in 12 unequilibrated ordinary chondrites. The occurrence of primordial inert gases, and the possibility of severe diffusion losses in certain carbonaceous chondrites leads to the following considerations: (1) U, Th–He ages cannot be estimated for the C1 and C2-types carbonaceous chondrites; (2) only "minimum" $^{3}He_{c}$-ages can be estimated for the C1 and C2-types carbonaceous chondrites; and (3) $^{38}Ar_{c}$-ages cannot be estimated for any of the meteorites, except Karoonda. The radiation ages of the carbonaceous chondrites and of the UOC are not grossly different from those of the ordinary chondrites. However, the following trends can be noted: (1) the ages of the C1 and C2 carbonaceous chondrites are on the average shorter than those of the ordinary chondrites; none of the former is greater than 15 Myr; (2) four, perhaps five C2 carbonaceous chondrites, Boriskino, Cold Bokkeveld, Haripura, Nawapali, and Nogoya come from a single collision 0.1–0.6 Myr ago, with the most likely date of 0.2±0.1 Myr. Author

N68-11880*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

AN EVALUATION OF GEOMAGNETIC HARMONIC SERIES FOR 1100 KILOMETERS ALTITUDE

F. T. Heuring, A. J. Zmuda, W. E. Radford, and P. Verzariu Sep. 1967 19 p refs

(NASA Order R-21-009-004; Contract NOw-62-0604-C)

(NASA-CR-9054) CFSTI: HC $3.00/MF $0.65 CSCL 08N

Magnetic intensities obtained with satellite 1964-83C are used to evaluate six harmonic sets being considered in relation to an International Geomagnetic Reference Field. As the number of terms in each series increases, the rms difference between observed and computed values decreases first rapidly and then slowly but ultimately reaches a plateau value. The GSFC 12/66 field of Cain et al give the best fit to the observations with the rms residual ultimately equalling 67γ for geomagnetic intensities in the range 15,000 to 31,000γ. Author

N68-11889# Public Health Service, Cincinnati, Ohio. National Center for Air Pollution Control.

SOURCES OF POLYNUCLEAR HYDROCARBONS IN THE ATMOSPHERE

R. P. Hangebrauck, D. J. Von Lehmden, and J. E. Meeker 1967 51 p refs

(PUB-999-AP-33; PB-174706) CFSTI: HC $3.00/MF $0.65

Rates of emissions of polynuclear hydrocarbons were measured at several sources considered likely to produce such emissions. The sources included heat generation by combustion of coal, oil, and gas; refuse burning; industrial processes; and motor vehicles. The annual emissions of benzo (a)pyrene in the United States were estimated for each of the sources surveyed, to provide a rough gauge of the importance of each source. Small, inefficient residential coal-fired furnaces appear to be a prime source of polynuclear hydrocarbons; other sources may be of local importance. Production of polynuclear hydrocarbons was generally associated with conditions of incomplete combustion. Author (TAB)

N68-11898# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.

DYNAMICS OF THE ANTARCTIC CIRCUMPOLAR CURRENT (ACC), PART 3

Takashi Ichye Apr. 1967 33 p refs

(Grant NSF GA-258)

(CU-2-67, Pt. 3; PB-174942) CFSTI: HC $3.00/MF $0.65

A dismensional analysis is applied to the circulation around Drake Passage. It indicates presence of the frictional boundary layer (due to horizontal eddy viscosity) with a width of the order of 10 km off the meridional coasts, in contrast with the frictional and inertia boundary layer with a width of the order of 100 km in the mid-latitude ocean. The western boundary current off the east coast of South America flows northward and southward respectively in the southern and northern part and has a width of about 300 km. The inertia terms tend to increase the widths of both the western boundary layer and the current there. The boundary current off the west coast of South America is broad and ill-defined and its intensity and direction is governed by the wind stress distribution there as well as the bottom topography and the coastline orientation. The southern boundary layer off the Antarctic Continent in general is much broader than off the meridional coasts and has a width of the order of 600 km but in some locations like Weddel Sea and Ross Sea there are jet-like eastward currents due to a leeward eddy effect of the coastline, forming counter currents there. Author (TAB)

N68-11901# Naval Oceanographic Office, Washington, D. C.

THE OCEAN SCIENCE PROGRAM OF THE U.S. NAVY: ACCOMPLISHMENTS AND PROSPECTS

Jun. 1967 110 p

(AD-657389)

Contents: Introduction; (objectives of the oceanscience program, Organization and management, the history of ocean science in the Navy), The Navy ocean science program; (physical oceanography, chemical oceanography, marine geology and geophysics, oceanic biology, underwater sound, environmental prediction, engineering research, instrumentation, special-purpose platforms, ocean data stations), Major accomplishments; (oceanic circulation, thermal structure, wave forecasting, physiography, sediment and crustal structure, gravity and geodesy, arctic, geophysical instruments and systems, oceanographic buoys, deep underwater vehicles, man-in-the-sea program), Support of other

national objectives; (marine food resources, transportation, mineral and energy resources, weather prediction, public health and recreation, engineering, international understanding and cooperation, education). Prospects for the future; (ocean dynamics, air-sea interaction, chemistry of the ocean, benthic boundary studies, sea floor topography and sediment studies, crustal and subcrustal studies, oceanic biology, underwater sound, scientific platforms and instrumentation, major cooperative experiments, ocean exploration and exploitation). Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-11031# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

APPLICATION OF FOURIER SERIES EXPANSION FOR THE ADJUSTMENT OF AN ELEVATION PHOTOGRAMMETRIC NETWORK WITH THE USE OF DIFFERENT ELEMENTS FOR THE EXTERNAL ORIENTATION OF AERIAL PHOTOGRAPHS [PRIMENENIYE RAZLOZHENIYA V RYAD FUR'YE DLYA URAVNIVANIYA VYSOTNOY FOTOGRAMMETRICHESKOY SETI S ISPOL'ZOVANIYEM OTDEL'NYKH ELEMENTOU VNESHNEGO ORIYENTIROVANIYA AEROSNIMKOV]

V. I. Pavlov Sep. 1967 41 p refs Transl. into ENGLISH from the Publ. "Fotogrammetricheskaya Obrabotka i Deshifrirovaniye Aerosnimkov" Leningrad, Nauka, 1967 p 5–30
(ACIC-TC-1288; TT-67-63057; AD-659646)

A new method is suggested for the adjustment of the altimetric photogrammetric network, based upon the application of the Fourier series for the leveling of the differences between the independently determined orientation elements of similar aerial photographs. This method is also based on the use of equations for the surface of first and second order distortion for the interpolation of the discrepancies of elevations, obtained at the reference points. Author (TAB)

N68-11058 United Kingdom Atomic Energy Authority, Windscaley (England). Production Group.

THE EXPERIMENTAL DETERMINATION OF THE PHOTOPEAK EFFICIENCIES OF NaI (Tl) DETECTORS FOR CYLINDRICAL GASEOUS SOURCES

V. Barnes and J. J. Wilson 1967 12 p refs
(PG-792(W)) HMSO: 1s 9d

A technique is described whereby the photopeak efficiency of a NaI(Tl) spectrometer for a gaseous source of a gamma-emitting isotope may be determined without reference to a standard gaseous source. The method makes use of calibrated solutions of radioactive isotopes which emit gamma photons of energy close to that of the radioactive gas to be measured. A knowledge of the abundance of the unconverted gamma photons emitted by the calibrated solutions and by the gaseous isotope is also required. The underlying theory and the experimental details of the technique are described and also experiments to test the validity of results. Factors affecting the accuracy of the results are discussed and the variation of photopeak efficiency with photon energy is given for a 3 in. × 2 in. diameter gaseous source resting on a 3 in. × 3 in. NaI(Tl) crystal. Author

N68-11061# California Univ., Livermore. Lawrence Radiation Lab.

HAZARDS CONTROL Progress Report Jan.–Apr. 1967

Apr. 1967 61 p refs
(Contract W-7405-ENG-48)
(UCRL-50007-67-1; PR-27) CFSTI: HC$3.00/MF$0.65

The designs and uses of radiation detectors, air samplers, fire and smoke detectors, and respirators for use in hazards control are discussed. NSA

N68-11072* California Univ., Berkeley. Space Sciences Lab.

SITE EVALUATION FOR A MAJOR PLANETARY TELESCOPE

Samuel Silver [1967] 94 p refs
(NASA-CR-90229; UCBSSL-229) CSCL 03A

The construction, installation, and operation of (1) an all-sky camera for continuous monitoring of cloud cover, (2) a water-vapor-atmospheric extinction photometer for monitoring total atmospheric precipitable water and atmospheric extinction, and (3) various sensors for measuring meteorological parameters, is described. Preliminary data are given. Further data will be collected, and are to be used in an evaluation of a site for a major planetary telescope. L.S.

N68-11080# Naval Research Lab., Washington, D. C.

USE OF EULER TRANSFORMATIONS IN THE DETERMINATION OF ROCKET ORIENTATION Final Report

Robert R. Meier 17 Jul. 1967 30 p refs
(NRL-6537; AD-659951)

An analytical treatment of data from rocket aspect sensors (such as magnetometers and solar sensors) was developed in terms of Euler angle coordinate systems and transformations, since the Euler angles represent the zenith, azimuth, and spin angular coordinates of the rocket. It was found that the relationships between the sensor outputs and the orientation of the rocket are exceedingly straightforward when considered in terms of these coordinate transformations. Three cases of aspect sensor combinations were considered: complete magnetometer data were assumed in each of the three cases (except for consideration of failure of one of the three magnetometers) with supplementary information in case 1 from continuous sun sensor coverage, in case 2 from partial sun sensor data, and in case 3 from horizon scanners. The equations are derived for ideal experimental conditions (instrumental errors are neglected). The solutions can easily be programmed on a computer. A general computer program was not developed, however, because the problems encountered in the reduction of aspect data vary considerably for each rocket flight. Author (TAB)

N68-11117# Army Nuclear Defense Lab., Edgewood Arsenal, Md.

A SUPERCONDUCTING THIN-FILM NUCLEAR-PARTICLE DETECTOR

Donald B. Sullivan Oct. 1967 50 p refs
(NDL-TR-93; AD-660338)

Recent advances in theory and development of a superconducting nuclear-particle detection technique are presented. A review of previous theory as well as recent theoretical work is included. Experimental results obtained at US Army Nuclear Defense Laboratory and through contract with Satomics International, a division of North American Aviation, are compared with the existing theory. The report is intended, not only to present results of recent work, but also to provide a summary of all developmental work. The problems encountered in the research are discussed and some suggestions are offered as possible paths to solutions. Author (TAB)

N68-11150# Navy Electronics Lab., San Diego, Calif.
A NUCLEAR-MAGNETIC-RESONANCE SPECTROMETER
Research and Development Report, Sep.–May 1966
R. E. Kvarda 9 Jun. 1967 47 p refs
(NEL-1471; AD-659778)

A spectrometer of the Pound-Knight-Watkins type has been designed and constructed for studies of nuclear-magnetic-resonance absorption in solids. It may be used for room-temperature studies of single crystals to determine the components of the electric-field-gradient (EFG) matrix, the asymmetry parameter, and the orientation of the principal axes of the EFG matrix at nuclear sites. Recordings are given as an indication of performance. Author (TAB)

N68-11154 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
THIN-FILM GAUGES FOR HEAT-FLUX MEASUREMENTS IN SHOCK TUNNELS [PLATINFILMELEMENTE ZUR MESSUNG DES WAERMEUEBERGANGES IN STOSSWELLENWINDKANAELEN]
P.-J. Weber Sep. 1967 43 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-15) CFSTI: $3.00

The report deals with thin-film gauges for the measurement of temperature and heat-flux in shock tubes and gun tunnels. Theory, preparation and application of these gauges and of analogue networks are discussed in detail. Finally some examples show the successful application of these gauges. Author

N68-11160# Aerospace Corp., El Segundo, Calif.
USE OF THIN-SKINNED CALORIMETERS FOR HIGH HEAT ARC JET MEASUREMENTS
Keith E. Starner Jul. 1967 22 p refs
(TR-0158(3240-10)-4; SAMSO-TR-67-13; AD-659742)

Fast-response, thin-skinned calorimeters provide a simple, rapid means of obtaining heat flux profiles of arc jet flows. A probe-sweeping technique is used to permit repeated radial profile measurements of heat flux during a single test run. It is shown that this technique is well suited for use in high heat flux environments when simplicity of calorimeter construction and data analysis is required. Such fast-response calorimeters also have application for catalytic surface measurements in nonequilibrium flows where time-dependent surface contamination is experienced. Experimental heat flux data from thin-skinned calorimeters used in arc jet flows are presented. Author (TAB)

N68-11163# Naval Research Lab., Washington, D. C.
ZERO SHIFT IN PIEZOELECTRIC ACCELEROMETERS
Interim Report
E. W. Clements 5 Sep. 1967 25 p refs
(NRL-6596; AD-659949)

Attempts to measure parameters of severe mechanical shock environments by use of piezoelectric accelerometers are often frustrated by the occurrence of zero shift. This phenomenon defeats measurements by rendering the reference line of the recorded waveform uncertain and perhaps preventing proper operation of recording circuitry as well. Possible causes include improper accelerometer application or recording techniques, as well as the design and material of accelerometer itself. In this study these possibilities have been restricted, so far as possible, to those involving the accelerometer alone, and the reactions of the zero shift phenomenon to variation of several shock parameters observed. Four accelerometers of various materials and constructions have been examined in this way. Of the two accelerometers which do not exhibit zero shift, one uses a ferroelectric ceramic element in shear mode and with light loading, and the other uses natural quartz in compression mode with moderate loading. Both of the accelerometers which do produce zero shift use ferroelectric ceramics in the compression mode with high loading. High stress on the sensing element is evidently an important factor. Further studies should attempt to explore temperature correlations as well as to separate the effects of element operating mode and stress. Author (TAB)

N68-11168 Hewlett-Packard Co., Palo Alto, Calif.
HEWLETT–PACKARD JOURNAL, VOLUME 19, NUMBER 3
Nov. 1967 21 p

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1. LOUDNESS EVALUATION W. E. Ohme p 2–11 (See N68-11169 02-14)
2. AUTOMATIC LOUDNESS ANALYSIS H. Blaesser and H. Finckh p 12–20 (See N68-11170 02-14)

N68-11169 Hewlett-Packard Co., Palo Alto, Calif.
LOUDNESS EVALUATION
Wolfgang E. Ohme *In its* Hewlett-Packard J., Vol. 19, No. 3 Nov. 1967 p 2–11 (See N68-11168 02-14)

Sound pressure and sound pressure level, sound fields, loudness level, and loudness as a function of frequency bandwidth, and proximity are discussed in a evaluation of loudness as the only objective measure of the disturbing power of a sound. Subjective pitch, loudness density, and masking are considered; and a sound level meter for measuring loudness is described. Loudness calculations by the procedures of Stevens and Zwicker are described, and curves depicting loudness are included for each procedure. Addition of partial loudnesses is part of both procedures, and the Zwicker method is considered as valid for impulsive sounds as it is for uniform sounds. There are eight different Zwicker diagrams, four for frontal sound fields of different maximum sound pressure levels, and four for diffuse fields of different levels. M.W.R.

N68-11170 Hewlett-Packard Co., Palo Alto, Calif.
AUTOMATIC LOUDNESS ANALYSIS
Heinz Blaesser and Helmut Finckh *In its* Hewlett–Packard J., Vol. 19, No. 3 Nov. 1967 p 12–20 (See N68-11168 02-14)

The subjective sensation of loudness is considered easy to measure with a loudness analyzer that simulates the known characteristics of the human ear according to the Zwicker method. This analyzer can measure both wideband or narrow band, continuous or impulsive sounds; and can take inputs from a microphone or a tape recorder. A typical analysis of a single typewriter stroke is illustrated. The recorder plot requires less than two minutes, and the electrical signals representing the sounds to be analyzed are separated into 20 channels by active bandpass filters. Specifications for the analyzer are included; and its use in noise reduction, production testing, and speech analysis is noted. M.W.R.

N68-11175*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334S Quarterly Progress Report, Jul. 1–Oct. 1, 1967
Richard S. Johnson and Lynn Rood 15 Oct. 1967 14 p Prepared for JPL
(Contracts NAS7-100; JPL-951529)
(NASA-CR-90335; Rept.-20584-QR4; QPR-4) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Five spin motors were built and tested according to the vibration and shock requirements for a sterilizable wide angle gas bearing gyro. Five gimbal assemblies and all of the gyro subassemblies were completed. Two complete gyros were built and tested, with testing terminated on both of them after the spin motors failed to start following 30 hours of operation. M.W.R.

N68-11195# Naval Academy, Annapolis, Md. Engineering Dept.
OPTICAL INVESTIGATIONS OF HEAT TRANSFER NEAR AN AIR-WATER INTERFACE
James A. Adams Jun. 1967 45 p refs
(Rept.-67-7; AD-659967)

The report is concerned with the evaluation of a recently constructed Mach-Zehnder interferometer which utilizes a gas laser light source. The feasibility using this instrument to study heat transfer rates in liquid media was demonstrated, and preliminary results are presented. The experimental procedures used in the adjustment, calibration, and evaluation are presented in detail. Temperature gradients were measured near a heated, submerged surface in a water tank, as well as in the thin thermal layer formed in the liquid at a liquid-air interface. Author (TAB)

N68-11268# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTODYNE TRANSDUCERS OF SIGNALS OF NUCLEAR MAGNETIC RESONANCE [AVTODINNYYE DATCHIKI SIGNALOV YADERNOGO MAGNITNOGO REZONANSA]
L. L. Dekabrun, Ya. N. Kil'yanov, and A. R. Mkrtchyan 18 Aug. 1967 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), v. 18, no. 3, 1965 p 134–142
(FTD-MT-66-69; TT-67-63231; AD-660410)

An analysis is presented of the stabilizing action of active negative feedback on autodyne pickups for the investigation of solids by the NMR method. In such applications, autodyne pickups have certain advantages over others, but must be stabilized when the signal voltage is low, such as is the case with solid-state NMR. The transients in an autodyne pickup with stabilized amplitude are calculated, and the modifications that must be introduced in the pickup circuit to ensure stability are described. Empirical means of selecting the autodyne circuit and its parts to obtain maximum sensitivity are suggested, since a theoretical analysis of this problem is impossible. A schematic diagram of a pickup with stable operation at less than 0.005 volt on the resonant circuit is presented. This circuit has been thoroughly tested and proved itself in practical investigations of several natural compounds by the NMR method. Author (TAB)

N68-11271# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS OF OUTER ORIENTATION OF PHOTO DURING OPTICAL AXIS ORIENTATION ON THE CENTER OF BRIGHTNESS OF THE CELESTIAL BODY
G. B. Gonin 1 May 1967 18 p Transl. into ENGLISH from Akad. Nauk SSSR. Spets. Vopr. Fotogrammetrii (USSR), 1966 p 21–30
(FTD-HT-66-616; TT-67-63133; AD-659910)

One variation of the title of this article would be: The Elements of external orientation of Photographs When the Optical Axis is Oriented on the Center of Brightness of a Celestial Body. A system for this orientation is described and the coordinates of the brightness center are calculated. Author (TAB)

N68-11277* Toronto Univ. (Ontario). Inst. for Aerospace Studies.
CALIBRATION OF A MICROMETEOROID IMPACT GAUGE
Metod Gorjup Mar. 1967 72 p refs
(Grant NsG-633)
(NASA-CR-90129; UTIAS-TN-97) CSCL 14B

Response of a piezoelectric micrometeoroid impact gauge to elastic and inelastic impacts is studied in detail. The elastic impacts were produced by either free-falling glass beads 245 to 305 μ in diameter (1.92×10^{-5} to 3.72×10^{-5} gm in weight) impacting with velocities up to 1.3 m/sec or by an electronic striker impacting with a momentum of the order of 10^{-2} dyne-sec. Inelastic impacts were achieved by accelerating glass beads, 41 to 191 μ in diameter (9.05×10^{-8} to 9.12×10^{-6} g in weight), in a shock tube up to velocities of the order of 482 m/sec (1580 ft/sec). Output from the gauge varied linearly with momentum transfer for elastic and inelastic impacts. However, for the same direct momentum transfer, the inelastic impacts yielded a substantially larger output. Studied were also the craters produced by glass beads accelerated in the shock tube and impacting on aluminum, brass and steel targets. Data agree with current theory that the penetration varies as the velocity to the two-thirds power. Some unsteady-state drag coefficient results (Reynolds number range: $50<R_e<1000$; relative Mach numbers range: $0.51\leq M_R\leq0.69$; $0.02\leq M_R/\sqrt{R_e}\leq0.07$) for spherical glass beads (41–191 μ in diameter) accelerated by the flow behind the shock wave Mach number $\simeq$1.7, channel pressures: 50 mm Hg, 100 mm Hg) were obtained. Author

N68-11301 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
HIGH RESOLUTION SILICON SURFACE BARRIER RADIATION DETECTORS USING α AND β SPECTROMETRY [RIVELATORI AL SILICIO DEL TIPO A BARRIERA SUPERFICIALE PER SPETTROMETRIA α E β AD ALTA RISOLUZIONE]
D. Coiante, L. Parisi Presicce, and V. Spoglia 1967 21 p refs In ITALIAN; ENGLISH summary
(RT/EL(67)1)

The present work describes a method permitting to make high resolution surface barrier silicon radiation detectors. Some α and β spectrometry measurements are also shown. Author

N68-11326# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
TIME RESPONSE AND AERODYNAMIC HEATING OF ATMOSPHERIC TEMPERATURE SENSING ELEMENTS
Roberto Rubio and Harold N. Ballard Ft. Monmouth, N. J. Army Electron. Command Aug. 1967 38 p refs
(ECOM-5147; AD-660321)

Atmospheric temperature sensing elements described in this report are presently being used at meteorological rocket network stations. The thermal time response and dissipation factors of the sensing elements and of their respective mounts are evaluated as functions of altitude, aerodynamic corrections, which are a function of fall velocity of the sensing instrument, are also presented. Utilizing empirical data, temperature-versus-altitude profiles obtained with the STS and arcasonde systems are compared. The computer program is Fortran IV language, used to evaluate the above stated parameters, is summarized. Author (TAB)

N68-11336# Army Electronics Labs., Fort Monmouth, N. J.
POTENTIAL CONTRIBUTIONS OF GAS CHROMATOGRAPHY TO ELECTRONICS RESEARCH
Carol K. Pearce, Joseph E. Ellison, Jr., William Hessel, and George W. Heunisch Jul. 1967 66 p refs
(ECOM-2858; AD-659772)

Applications of gas chromatography as an analytical, preparative, and research tool for future use at ECOM are discussed. Areas of current use at ECOM are described, and device applications are suggested for future consideration. Author (TAB)

N68-11368*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT SLOPE—ANALYSIS OF THE PERFORMANCE OF THE LUNAR ORBITER 1 AND 2 IMAGING SYSTEMS Final Report

M. J. Mazurowski, T. M. Holladay, and R. E. Kinzly 15 Sep. 1967 136 p
(Contract NAS1-5800)
(NASA-CR-66494; CAL-VS-2182-D-4) CFSTI: HC $3.00/MF $0.65 CSCL 14E

The results of an evaluation of the performance of the Lunar Orbiter I and II imaging systems, based upon the quality of the reconstructed photography, is presented. The performance of both imaging systems with respect to signal detail rendition was nominal. The noise level measurements yielded data that were smaller than the nominal values, but consistent with the excessive exposures attained on most of the frames analyzed. The data representing the dc signal level response did exhibit some variations, possibly caused by a nonlinear response of the ground reconstruction system or incomplete processing of the film in the spacecraft. In addition, the medium resolution photographic frames were overexposed such that most of the recorded densities are outside the range where sensitometric control is provided. Author

N68-11367*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A RUGGEDIZED THIN-WINDOW PROPORTIONAL-COUNTER TUBE
Herbert W. Schnopper and Rex A. Shields 15 Sep. 1967 7 p refs
(Contract NAS7-100)
(NASA-CR-90428; JPL-TM-33-221) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design and testing of a thin-window proportional-counter tube are described. The objective of this investigation was the development of a component suitable for use in space experiments involving the detection of X-rays from light elements. The stability, efficiency, and resolution of the tube described here are consistent with space-application requirements. In a series of tests, it was determined that 0.25-mil aluminum-coated Mylar, supported by a nickel screen, provided maximum strength with minimum absorption. Two methods of sealing the window are described: (1) an O-ring and (2) a potting compound. Sodium Kα pulse-height distributions from the thin-window tubes are compared with those from a standard commercial tube having a mica window. Author

N68-11402 Electrotechnical Lab., Tokyo (Japan).
RESEARCHES ON ESTABLISHING OF PRIMARY STANDARDS OF SMALL CAPACITANCES
Taizo Iijima, Akira Kobayashi, Tameyasu Tsukada, Eiichi Teshigawara, Kenji Narita et al Dec. 1966 84 p refs In JAPANESE; ENGLISH summary
(Rept.-670)

Studies conducted in China and other countries to establish small capacitance standards are reviewed, with capacitance values ranging from 0.001 to 1.0 pF considered in this category. Guard-ring construction and a theoretical analysis of guard-ring type capacitors are included; and it is noted that an accuracy of about 0.1% is obtained with these capacitors. The design of ETL-type capacitors, with capacitance values of 0.001 to 1 pF, is described as an improvement on the guard-ring type. Electrical measurements of small primary and secondary standards are described; and the basic design and principal dimensions of a new standard capacitor with a capacitance value of 0.1 pF are described. M.W.R.

N68-11407*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT SLOPE—A STUDY OF LUNAR ORBITER PHOTOGRAPHIC EVALUATION TECHNIQUES, IMPLEMENTATION AND ACCURACY Final Report
R. E. Kinzly and M. J. Mazurowski 1 Apr. 1967 185 p refs
(Contract NAS1-5800)
(NASA-CR-66493; CAL-VS-2182-D-3) CFSTI: $3.00 CSCL 04E

The second phase of a continuing Study of Lunar Orbiter Photographic Evaluation (Project SLOPE) was conducted for the primary purpose of implementing measurement techniques for the image quality parameters selected in the first phase of the effort and for evaluating their accuracy. Extensive use is made of computer-simulated imagery and actual imagery obtained from the preflight readout of the Goldstone test film in the latter task. The quality parameters are related to the objectives of the Lunar Orbiter photographic system through the use of specified system performance criteria. The effects of the attainable accuracy for the quality parameter measurements on the criteria determination are also evaluated. Several secondary studies which are reported include brief investigations of the feasibility of improved quality parameter estimation techniques. It was found that by making a reasonable number of measurements on the GRE film utilizing the targets specified in the first phase effort, the expected error of the estimates of the system performance criteria is about 10%. The limitation is primarily imposed by the accuracy of the measurement techniques for the noise level quality parameter. The computer programs developed during the first phase effort have been revised to facilitate anticipated large volumes of data and to take advantage of new computational forms developed during the second phase effort. Author

N68-11408*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT SLOPE—A STUDY OF LUNAR ORBITER PHOTOGRAPHIC EVALUATION SECONDARY ANALYSIS TASKS Final Report
M. J. Mazurowski and T. M. Holladay 15 Sep. 1967 19 p
(Contract NAS1-5800)
(NASA-CR-66495; CAL-VS-2182-D-5) CFSTI: HC $3.00/MF $0.65 CSCL 14E

The results of several secondary analysis tasks conducted under Phase III of Project SLOPE are presented. The primary task, the analysis of the performance of the Lunar Orbiter II imaging system, is reported elsewhere. The analyses reported involve: (1) evaluation of the detail rendition or modulation transfer function to assess the extent of image motion compensation in an oblique photographic mode, and (2) evaluation of increased detail rendition in the image when compensation is employed at the lower image motion rates (i.e., low V/H rates). In addition, improvements in the data processing techniques implemented at the beginning of the Phase III effort are described. It was found that in the oblique photographic mode required to obtain high resolution convergent stereo pairs, the ground resolution will show a decrease from 1 meter to 2 to 4 meters. It was also determined that image motion compensation is effective for V/H rates as low as 3 milli-radians/second. Author

N68-11468*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIME SYNCHRONIZATION OF REMOTE STATION CLOCKS
Francis L. Stetina Mar. 1967 14 p refs
(NASA-TM-X-63036; X-553-67-130) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A report on the limitations of present methods of obtaining time synchronization of remote station clocks, and the inadequacy of these methods in meeting present and future Apollo time synchronization requirements. Author

N68-11469*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF RADIATION DAMAGE TO ATM FILM
Russell D. Shelton and A. C. de Loach 20 Oct. 1967 30 p refs
(NASA-TM-X-53666) CFSTI: HC $3.00/MF $0.65 CSCL 14E

Potential radiation damage to Apollo Telescope Mount (ATM) photographic film is analyzed in view of the fact that they will be subjected to a proton flux during the mission. Proton dose rates are calculated as functions of orbital inclination, altitude, and shielding thickness; film sensitivities of proton radiation are determined experimentally. Film darkening is then expressed as a function of elapsed time in orbit. It is concluded that several ATM films would not survive the radiation environment; research and test programs are underway to provide substitute emulsions which can be protected with a modest shielding requirement. Author

N68-11481# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REAL TIME SAMPLING OF ZINC SULFIDE TRACER IN DIFFUSION STUDIES

W. L. Dotson, P. W. Nickola, and M. A. Wolf 5 Sep. 1967 19 p refs Presented at USAEC Meteorol. Inform. Meeting, Chalk River, Ontario, Can.

(Contract AT(45-1)-1830)

(BNWL-SA-1407; CONF-670931-4) CFSTI: HC $3.00/MF $0.65

A real time sampler has been developed for the measurement of instantaneous atmospheric concentrations of zinc sulfide particulates. The requirements for such an instrument and its subsequent evolution for both surface and airborne applications are presented. Salient features of real time sampler records from several diffusion tests are discussed. The airborne instrument is shown to provide vertical definition of the tracer distribution which is not otherwise available. Comparisons are made of the time-integrated concentrations across the tracer plume, measured by the filter samplers of the Hanford diffusion grid, and the instantaneous cross-plume concentrations defined by the real time samplers. The instantaneous properties of the continuous plume emphasize the local influences which perturb the mean flow, while the relationship of the instantaneous properties to the time-averaged properties provide additional insight into the nature of the instantaneously generated puff. An improved airborne real time sampler, which is nearly ready for testing, has been modified to extend its usefulness by reduction of spurious signals. Author (NSA)

N68-11484 Naval Missile Center, Port Mugu, Calif.

A COMPENDIUM ON OPTICAL RADIATION DETECTORS

N. E. Van Slyke (M.S. Thesis—San Diego State Coll.) 3 Oct. 1967 298 p refs

(NMC-MP-67-13; AD-659986)

The report is a short treatise on optical radiation detectors. It is intended to be used as a reference work by persons who wish to measure radiation in the optical portion of the electromagnetic spectrum. The optical spectrum lies between 0.01 micron and 1,000 microns. There are sections on the theory of detection and cataloged data on commercially available detectors. Author (TAB)

N68-11501# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A PROBABILISTIC MODEL OF THE PHOTOGRAPHIC PROCESS [O VEROYATNOSTNOY MODELI FOTOGRAFICHESKOGO PROTSESSA]

M. A. Ayngorn 26 Apr. 1967 38 p refs Transl. into ENGLISH from Probl. Peredachi Inform. (Moscow), no. 16, 1964 p 69–90

(FTD-HT-66-632; TT-67-63127; AD-659877)

The purpose of the paper was to develop a model of the photographic process which can be used in solving a number of important problems related to the analysis and synthesis of actual photographic systems; the most important of these are: the determination of the information content of photographic data, the determination of the optimal procedure for extracting data from photographic negatives (optimal microdensitometry), the determination of optimal methods of encoding and decoding of optical images using photographic systems for their transmission. The probabilistic character of the photographic process is discussed and a probabilistic model of such a process is proposed. An analytical comparison between the fundamental characteristics of the actual photographic process and its developed model has shown that they are in good agreement. Author (TAB)

N68-11761*# Perkin-Elmer Corp., Norwalk, Conn.

ACTIVE OPTICAL SYSTEM FOR SPACEBORNE TELESCOPES, VOLUME 2 Final Report

7 Dec. 1967 57 p

(Contract NAS1-5198; Proj. SPO-27563)

(NASA-CR-66489; Rept.-8841, V. 2) CFSTI: $3.00/MF $0.65 CSCL 20F

A refinement of the control technique for actively controlling rigid segments of a telescope primary mirror is given. The refined concept allows the figure error sensor to integrate over a large portion of each segment to average out small surface irregularities and provides a degree of immunity to mechanical transients. Using this technique, the figure error of the composite 20-inch mirror was significantly reduced. Author

N68-11787* Virginia Univ., Charlottesville.

AN ANNULAR LITHIUM-DRIFTED GERMANIUM DETECTOR FOR STUDYING NUCLEAR REACTION GAMMA-RAYS

Arthur J. Levy (Ph.D. Thesis) Aug. 1968 132 p refs Sponsored in part by NSF

(Grant NsG-455)

(NASA-CR-90545) CFSTI: $3.00 CSCL 18D

Lithium drifted germanium gamma detectors were fabricated in the form of 1" long annular cylinders with a 3/16" diameter coaxial hole. Fabrication techniques and testing procedures for the detectors are detailed. The efficiencies of these annuli were measured at energies from 0.5 to 9 MeV. The effect of source distance, h_γ, on intrinsic photoefficiency was measured. Graphs of intrinsic efficiency vs. E_γ for the photopeak, double-escape peak, and single escape peaks are presented as well as graphs giving ratios of double-escape to photopeak efficiency vs. E_γ, full-energy to single escape efficiency vs. E_γ, and double-escape to single-escape efficiency vs. E_γ. One such Ge(Li) annulus was used as the center crystal of a three crystal spectrometer to study the Mg^{24} gamma decay following the $Na^{23}(d,n)Mg^{24}$ reaction. The deuteron bombarding energy was 0.990 MeV. Of the 84 observed transitions attributed to the decay of Mg^{24}, 35 of these are unreported in the literature. 103 additional transitions remain unidentified. The Mg^{24} states at 9.5 MeV (4^+, 6^+) and 8.44 MeV are observed to be doublets as was suggested by Ollerhead, et al., at Chalk River. The measured energies of these doublets were 9528±3 keV, 9508±7 keV and 8437±4 keV, 8424±3 keV. The use of a Ge(Li) detector permitted clear observation of many of the transitions so that branching ratios previously reported by Endt and Van der Leun have been refined. Author

N68-11788 National Engineering Lab., Glasgow (Scotland).

LABORATORY EVALUATION OF THE VIBRATORY CAVITATION EROSION TEST

J. M. Hobbs, A. Laird, and W. C. Brunton Jan. 1967 32 p refs

(NEL-271) CFSTI: HC $3.00

The application of an ultrasonic magnetostrictive vibrator to cavitation erosion testing has been investigated in detail and found to be satisfactory. Erosion rates were seen to depend on amplitude, frequency and water temperature for a given size of testpiece. Although the rate of erosion varied according to the stage

of damage attained, it was sensibly constant and unaffected by the surface roughness and surface hardness of the testpiece when the volume removed lay between 5 mm^3 and 15 mm^3, irrespective of material. Tentative standard conditions for comparative tests on different materials have been confirmed and tolerances imposed in order to ensure consistent results. The design of the testpieces is also discussed. Author

N68-11795# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
A SCINTILLATION COUNTERS APPARATUS FOR THE STUDY OF THE ANGULAR DISTRIBUTIONS OF PROTONS IN THE (E,E'P) EXPERIMENT [UN COMPLESSO DI CONTATORI A SCINTILLAZIONE PER LO STUDIO DELLA DISTRIBUZIONE ANGOLARE DEI PROTONI NELLA REAZIONE (E,E'P)]
G. Campos Venuti 30 Jun. 1967 31 p refs In ITALIAN; ENGLISH summary
(ISS-67/17) CFSTI: HC $3.00/MF $0.65

The choice of the annular scintillation counters system to study the angular distributions of the protons in the (e,e'p) experiment is justified. Preliminary testing and adjustment are discussed. Author

N68-11825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW LOOK AT THE BROWN–TWISS INTERFEROMETER
Frank C. Jones Oct. 1967 28 p refs Revised
(NASA-TM-X-55657; X-641-67-13) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A question that often arises when one is attempting to understand the principles underlying the Brown–Twiss stellar interferometer is "How can there be any kind of interference phenomena with light produced by incoherent sources?" Starting from the familiar interference pattern produced by two coherent sources we may proceed in simple steps to a picture of two incoherent sources producing an interference pattern that jumps about at random. This randomly jumping pattern leaves behind a "footprint," however, in the form of the intensity auto-correlation function. How the autocorrelation function for an extended, incoherent source may be constructed is shown. It is this function that is measured by the Brown–Twiss stellar interferometer. Author

N68-11867*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SENSITIVITY OF QUARTZ, PIEZOELECTRIC PRESSURE TRANSDUCERS AS A FUNCTION OF TEMPERATURE FROM 20° TO 477°K
Lloyd W. Canfil and William C. Nieberding Washington Dec. 1967 9 p refs
(NASA-TM-X-1479) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Quasi-static calibrations were performed to determine the sensitivity of quartz, piezoelectric type, pressure transducers in the temperature range of 20° to 477°K. Results were obtained which show that the sensitivity at 20°K differs from the sensitivity at room temperature by 4 percent maximum. The corresponding difference at 477°K is 9 percent. The change in room temperature sensitivity due to each temperature excursion was negligible. The conclusion is reached that this type of transducer is particularly applicable to dynamic pressure measurement at cryogenic temperatures. Author

N68-11869*# Stanford Univ., Calif. Instrumentation Research Lab.
A COMPUTER OPERATED MASS SPECTROMETER SYSTEM
Walter E. Reynolds, James C. Bridges, Timothy B. Coburn, and Robert B. Tucker 1 Nov. 1967 51 p refs
(Grant NsG-81; Contract AF 49(638)-1599; Grant FR 00151)
(NASA-CR-90754; IRL-1062) CFSTI: $3.00 CSCL 20F

A mass spectrometer-computer system has been devised to utilize the decision making capabilities of the modern digital computer. The system described assists the researcher user by allowing a computer to query the researcher for operating parameters. The computer translates these into detailed control functions that operate the instrument. The data acquired from the mass spectrometer is made available to the researcher in an on-line system. The system employs a small digital computer and an integer resolution quadrupole mass spectrometer. A reference gas is valved into the mass spectrometer by computer control to permit automatic calibration. Spectra processing of GLC effluent was demonstrated; the means and results are given. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-11025* Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
THEORETICAL AND EXPERIMENTAL STUDIES OF VISCO TYPE AND BUFFERED SHAFT SEALS Semiannual Progress Report, 15 Apr.–15 Oct. 1967
William K. Stair, Charles F. Fisher, Jr., and Ted A. Arehart, Jr. Oct. 1967 26 p refs
(Grant NsG-587)
(NASA-CR-90309; ME-67-587-10) CFSTI: $3.00 CSCL 13A

The experimental performance of three grooved-shaft viscoseals is presented and the theory developed under this project is compared with independently obtained data. These results, in addition to those for twenty geometries previously reported, indicate that the theory advanced provides a good design estimate for grooved-shaft viscoseals in both laminar and turbulent regions. The study of gas ingestion in viscoseals indicates that surface tension may play a dominant role in low-clearance viscoseals and that gas ingestion can occur in annular geometries even in the absence of grooves. Author

N68-11029* Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
ESTABLISHMENT OF PARAMETERS AND LIMITATIONS OF EXPLOSIVE WELDING Final Report, 27 Jun. 1964–27 Jul. 1965
F. C. Polhemus 27 Aug. 1965 102 p refs
(Contract NAS8-11738)
(NASA-CR-90209; PWA-FR-1528) CSCL 13H

The analogy of a supersonic stream incident upon a wedge was used to describe the interface configuration of explosive welds. An examination of specimen welds indicates that the velocity of the metal jet was slightly less than that of the normal shock wave on the surface of the metal. The process parameters for effecting explosive patch welds in 1/8-inch thick X-7106-T6 and 1/4-inch thick X-7106-T6351 aluminum alloy were established and demonstrated through testing. Sound explosive scarfed welds were fabricated in 0.125-inch thick X-7106-T6 and 0.150-inch thick X-7105-T6351 aluminum alloy material. Data obtained from overlapped and scarfed explosive welds indicate that the strength of the material adjacent to the weld was decreased by

work-hardening during forming to the preweld configuration or by shock wave impact during explosive welding. Sound T explosive welds of 0.250-inch thick X-7106-T6351 aluminum in lengths as great as 36 inches were accomplished. The quantity of explosive was approximately 44% greater than had been estimated, and brought about the failure of the tip of the T weld die. Author

N68-11045* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A HIGH TEMPERATURE, ELECTRICALLY INSULATING CERMET SEAL HAVING HIGH STRENGTH AND THERMAL CONDUCTANCE
Warner B. Kaufman, Richard F. Tischler, and Roland Breitwieser Washington 1967 19 p refs Presented at the Thermionics Conf., Palo Alto, Calif., 30 Oct.–2 Nov. 1967 Sponsored by the Inst. of Elec. and Electron. Engr.
(NASA-TM-X-52373) CFSTI: $3.00 CSCL 11A

A high temperature cermet seal has been developed for a research thermionic diode. The seal consists of one of more layers of alumina coated niobium particles sandwiched between thick niobium pieces and bonded by isostatic hot pressing. The hermetic seal has resistivity greater than five megohms at 1300°K, structural integrity to 1700°K, and exceptional thermal shock resistance to 1500°K. Tensile strengths of 25,000 psi initially and 13,000 psi after cycling several times to 1700°K were obtained. Thermal conductance about 0.6 that for niobium was indicated. Two simple compact cermet assembly configurations, planer and cylindrical, have been fabricated. Both are machinable and can be welded or brazed. Author

N68-11091# Western Electric Co., Inc., Princeton, N. J. Engineering Research Center.
DIE CAST AND MECHANICAL THERMAL PULSE TERMINATION TECHNIQUES
R. H. Cushman 1 Dec. 1967 30 p Presented at the 16th Ann. Wire and Cable Symp., Atlantic City, 29 Nov.–1 Dec. 1967
(AD-659892)

The paper describes a continuing study program that has resulted in two new families of termination techniques. Shielded cables are terminated by a die casting process, allowing the simultaneous forming of functional piece parts. Bare wire, magnet wire, ribbon cable and insulated wires are terminated by the MTP family of techniques. Bonds can be made rapidly using semi-automatic, manual or portable tools. It is possible in many cases to make terminations through the insulation without stripping and through appreciable contamination. Author (TAB)

N68-11111* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPILATION, MATERIALS AND DECONTAMINATE COMPATIBILITY TESTS FOR THE ANCHORED INTERPLANETARY MONITORING PLATFORM
W. Grenier Jul. 1967 521 p
(NASA-TM-X-63031; X-723-67-516) CSCL 13H

A compilation of tests conducted to determine compatibility of materials with cleaning and decontamination agents is presented. Studies consist of possible mechanical and physical effects of cleaning agents, solvents, and gaseous sterilizing mixtures on metals, plastics, adhesives, coatings and the like common to the AIMP. Tests include: mechanical, physical appearance, weight changes, reflectivity, ultraviolet radiation, microscopy, electrical, and solvent efficiency. Author

N68-11201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTICAVITATION DEVICE
P. S. Kashuba 2 Jun. 1967 7 p Transl. into ENGLISH from Russia Patent No. 177776 (Appl. No. 843372/25-8, 20 Jun. 1963) 2 p
(FTD-HT-66-671; AD-660415)

An anticavitation device is described for creating a backup pressure on the line of the input into the pump of a closed hydraulic system with constant pressure on the output of the pump. For the purpose of simplifying and improving the dependability of the system, it is designed in the form of a bellowslike shell located in the line of the input and a plunger supported on its bottom, which is placed inside a guiding sleeve and the free end of which is under the pressure on the output of the pump. In the bottom of the bellowslike shell there are holes for carrying away into the line of the input the leaks of liquid from the line of output through the gaps between the plunger and the guiding sleeve.
Author (TAB)

N68-11208# Naval Weapons Lab., Dahlgren, Va.
INVESTIGATION OF 18 PER CEN NICKEL MARAGING STEEL WE'DS BY TRANSMISSION ELECTRON MICROSCOPY
Robert W. Lowry 18 Oct. 1967 54 p refs
(NWL-2114; AD-660177)

18% nickel maraging steel is playing an increasingly important role in welded structures because of its superior strength. To optimize weld properties, it is necessary to understand the detailed features of the weld microstructure. The techniques of transmission electron microscopy and electron diffraction revealed microstructures and crystallographic data some of which were previously hypothesized but not observed. Dendritic and interdendritic structures are compared to that of the parent plate metal. The tungsten inert gas welding process does not appear to alter the response (precipitate formation) of the metal to heat treatment. Orientation relationships between weld phases were determined to be identical with the Kurdjumov–Sachs relationship. Author (TAB)

N68-11216# Army Electronics Labs., Fort Monmouth, N. J.
FINAL EVALUATION OF MACHINABLE, ACID-TREATED, RECONSTITUTED ALUMINA FOR ELECTRON TUBES
Stanley R. Leefe Aug. 1967 11 p
(ECOM-2874; AD-660286)

The report discusses cathode poisoning, metalizing and brazing, tensile and hermeticity seal tests made on acid-treated, reconstituted alumina (96% Al_2O_3). Tests were conducted to evaluate the effects, if any, the acid treatment has on the metalizing, tensile strength, vacuum and machining properties of the alumina. The report presents and evaluates the data obtained from the concluding tests of an internal program. Author (TAB)

N68-11232# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF FRICTION THEORY, WEAR AND LUBRICATION ACTION [VOPROSY TEORII TRENIYA IZNOSA I SMASOCHNOGO DEYSTVIYA]
N. D. Donchenko 31 Mar. 1967 6 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 12, 1965 p 107
(FTD-HT-23-500-67; TT-67-63212; AD-660344)

The article describes the scientific council on friction and lubrication of the Academy of Sciences of USSR which carried out on June 30 through July 3 in Moscow an All Union Conference on friction theory, lubrication action, and new lubrication materials. The conference was held in 7 sections: friction theory, wear theory, new structural materials for friction units, calculation and construction problems of friction units, testing methods, instruments and modeling theory, study of lubrication action and new lubrication materials. Highlights of the conference are discussed. Author (TAB)

N68-11282# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
LUBRICANT ADDITIVE EFFECTS UPON BEARING METAL FATIGUE. 2: EFFECTS IN MULTI-PURPOSE SOAP THICKENED GREASES
Max T. Fisher Aug. 1967 22 p refs
(RIA-67-2155; AD-660341)

To determine if additives in greases have effects upon bearing fatigue life overriding thickener and oil effects, greases of the Military Specification MIL-G-10924B type were made, with and without additives, using low viscosity naphthenic or paraffinic mineral oils thickened with calcium or lithium 12-hydroxystearate. They were tested in the rolling contact adaptation of the Four Ball Extreme Pressure Tester with 52100 steel balls at 1,200,000 psi Hertz load and ambient temperatures. Fatigue life improvement over the oils was greater using calcium soap instead of lithium soap as the grease thickener. Nonylphenoxyacetic acid was relatively ineffective for improving fatigue life in all greases except the lithium base paraffinic oil grease. The insoluble crystalline additives with good lubricating properties, molybdenum disulfide and molybdenum dibutyldithiocarbamate, were very effective for improving fatigue life in greases of both thickener types. The oil miscible molybdenum dibutyldithiophosphate in the calcium base paraffinic oil grease was nearly as effective as the latter, which was the best fatigue inhibiting additive tested, but was less effective than either of the above additives in the lithium soap paraffinic oil grease. With the less effective tricresyl phosphate the relative improvement of fatigue life in these two greases was reversed. Author (TAB)

N68-11300*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPILATION, METALLOGRAPHIC AND RELATED METALLURGICAL TESTS
W. G. Grenier Jan. 1966 210 p
(NASA-TM-X-63025; X-723-66-17) CFSTI: HC $3.00/MF $0.65
CSCL 13H

This compilation contains the metallurgical and related tests conducted during 1964 in support of specific spacecraft programs and the Advanced Technical Development effort. The studies cover: (1) feasibility of solar cell bonding with various gallium alloys; (2) microelectronic circuit anomalies; (3) corrosion, electrical resistance, and abrasion tests of coatings; (4) metallurgical examinations of Mo, Nb, Al, Ni, Be, Cu, and Cd connections or alloys; (5) development of a cone angle measuring system for a spin control unit; and (6) microscopic examination of miniature lamp filaments. K.W.

N68-11371 Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
PRESS FORGING LOADS FOR ANNULAR DISCS
M. J. Hillier Nov. 1967 13 p refs
(TN-3)

Die loads have been calculated in an elementary manner for the compression of rough and partially rough plane annular discs having a concentric circular hole. Both discs which are unconstrained and those which are subject to radial constraints at inner or outer radii are considered. Comparison is made with the die loads required for compression of rectangular slabs in plane strain having the same area and "radial" width. Results are also compared with upper bound solutions obtained elsewhere. Author

N68-11374# Atomics International, Canoga Park, Calif.
DIFFUSION BONDING OF TITANIUM ALLOYS Quarterly Report, 1 Dec. 1966–28 Feb. 1967
Curtiss A. Smith and Edward L. Reed Watertown Mass. Army Mater. Res. Agency 1 May 1967 27 p
(Contract DA-19-006-AMC-339(X))
(AI-67-137; AMRA-CR-66-10/1-3; QR-3; AD-660333)

The program attempts to develop an understanding of the diffusion bonding of titanium alloys; in particular, the alloy Ti-6Al-4V. The accomplishments of the third quarter of the program are as follows: A series of tensile and bend tests has been completed. These tests showed trends which were in reasonable agreement with the shear tests performed during the second quarter. Additional shear tests have been performed to extend the range of variables to greater pressures and shorter bonding times than those reported for the second quarter. Examination of bond line photomicrographs indicates a correlation between bonded length and relative tensile strength. This correlation may find practical use in estimating bond quality. Author (TAB)

N68-11376# Little (Arthur D.), Inc., Cambridge, Mass.
COMPLEX CEMENTED CARBIDES FOR METAL CUTTING TOOLS Final Report
Bennett Bovarnick Watertown, Mass. Army Mater. and Mech. Res. Center Oct. 1967 19 p refs
(Contract DA-19-006-AMC-00300(W))
(C-67788; AMMRC-CR-67-12(F); AD-660292)

A program was undertaken to develop the potential metal cutting performance which appeared to be offered by complex composite carbides obtained from fluid bed decomposition of their aqueous salt solutions to the composite powders. The work accomplished was able to verify that complex carbides of the tungsten, titanium and/or boron systems could be prepared by this process. Feed solutions of ammonium metatungstate with titanium ammonium lactate and boric acid, as appropriate, were decomposed in the fluid bed at temperatures about 900F to their corresponding composite oxides. The composite oxides were carburized to the complex carbides. Several series of experimental tools were cold pressed and sintered or hot pressed from the complex carbide powders. Improvement of properties was obtained with each successive series. Metal cutting performance of these tools showed corresponding improvement, although not attaining a level adequate for shop use. Detailed study of the experimental tool materials lead to the finding that continued process development work would be required to realize the cutting promise which is believed to be offered by the complex cemented carbides made from composite powders. Author (TAB)

N68-11425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF LIQUID-METAL MELTS IN DIFFERENT BRANCHES OF INDUSTRY
M. I. Chayevskiy 16 Jun. 1967 19 p refs Inst. Mashinovedeniya i Avtomat. (Ukrania), v. 9, no. 8, 1962 p 11–21
(FTD-MT-67-82; TT-67-63246; AD-660432)

The use of low-melting metal melts as operational media is illustrated by a number of examples in the field of thermal power engineering; foundry and heat treatment of metals; machine and instrument building and the glass industry. Except for a heat supply system in a Soviet metallurgical combine, using mercury or a sodium and potassium melt as heat carriers, all the models or systems presented are of American or British origin. They include: heat treatment and bright annealing furnaces; a system for cooling the valve of an internal combustion engine; a high-sensitive mercury bearing; electromagnetic pumps for the transportation of liquid metals, and the production of high-quality plate glass with the use of a molten metal bath. The author concludes that the wide use of liquid-metal melts as heat carriers will be only possible, when the problem concerning the operational capacity of materials being in contact with the melts has been solved. Author (TAB)

N68-11431# Atomics International, Canoga Park, Calif.
DIFFUSION BONDING OF TITANIUM ALLOYS Quarterly Report, 1 Sep.–30 Nov. 1966
Curtiss A. Smith and Edward L. Reed Watertown, Mass. Army Mater. Res. Agency 1 Feb. 1967 30 p refs
(Contract DA-19-066-AMC-339(X))
(AMRA-CR-66-10/1-2; AI-67-66; QR-2; AD-660332)

The program attempts to develop an understanding of the diffusion bonding of titanium alloys; in particular, the alloy Ti-6Al-4V. The accomplishments of the second quarter of the program are as follows: Instrumentation for the vacuum hot press was completed and calibrated. Tests were performed on the effects of temperature, pressure, time, and surface roughness on bond shear strength. The results of the bonding parameter studies indicate a dependence on plastic deformation but not a direct dependence on temperature or bonding pressure. An empirical fit has been made to the data and work is in progress to refine the mathematical description which was proposed during the first quarter. Tensile and bend tests were initiated. It was determined that the electron-beam microprobe is not sufficiently sensitive to detect the diffusion of oxygen or nitrogen in the alloys Ti-6Al-4V. Author (TAB)

N68-11433# Monsanto Co., Texas City, Tex. Hydrocarbons and Polymers Div.
THE EXTRUSION OF CELLULAR POLYETHYLENE INSULATION
R. H. Reinhard, C. L. Loney, and G. W. Daues [1967] 20 p refs Presented at the 16th Ann. Wire and Cable Symp., Atlantic City, 29–30 Nov.–1 Dec. 1967
(AD-660094)

The effects of certain extrusion variables on the diameter and capacitance uniformity of cellular insulation were studied using a multi-channel oscillograph. Operational parameters such as melt temperature and head pressure uniformity were varied to produce a poor and optimum extrusion quality level for each of six diverse screw designs. Screw design variables studied were helix angle and channel depth. Some common, but not easily detected problems, such as poor melt temperature uniformity, flow surging, and pre-foaming in the screw are described. Author (TAB)

N68-11447# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRPLANES: ADVANCES IN ASSEMBLY TECHNIQUES (2) WELDING, PLASTIC CEMENTING, HERMETIC SEALING
Chen-wen Wu 28 Apr. 1967 10 p Transl. into ENGLISH from Hang K'ung Chih Shih, v. 2 no. 3, 1965 p 18–19
(FTD-HT-66-799; TT-67-63213; AD-660342)

In a discussion of aircraft assembly, the author points out that rivets are not only heavy but also impair the structural property of an aircraft because holes are punched in its walls. As a result, welding and gluing are finding wider application in aircraft assembly. Both techniques are described briefly and it is then observed that their only drawback is that the parts thus assembled usually need more extensive inspection. Finally, the author discusses the hermetic sealing technique. Hermetic seals are essential for high-altitude flying. Three types of seals are considered: Surface seal, where the sealing material is applied to the whole surface of the assembled aircraft. Seam seal, where the sealing material is applied only between the joints of the plates and between the rivets, screws, etc. Compound seal, a combination of the first two types. Author (TAB)

N68-11448# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COPPER–MANGANESE SELF-FLUXING SOLDER [MEDNOMARGANTSOVISTYY SAMOFLYUSUYUSHCHIYSYA PRIPOY]
V. V. Orlova, S. V. Lashko, and N. F. Lashko 5 May 1967 6 p Transl. into ENGLISH from Russian Patent No. 128271 (Appl. No. 618501/25, 6 Feb. 1959) 1 p
(FTD-HT-66-626; AD-659816)

The copper-manganese self-flexing solder consisting of nickel, manganese, iron, lithium, and copper, is distinguished in that, for the purpose of obtaining quality solders for responsible aircraft construction, for example, of honeycomb fillers, and for the avoidance of inter-crystallite penetration in stainless steel, the following composition of solder in percentages is established: 4.0 - 4.8, manganese 20.0 - 24.0, iron to 1.0, lithium 0.15 - 0.20 and the remainder copper. Author (TAB)

N68-11486 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION FOR EVALUATING BONDING IN LARGE METALLIC BEARINGS [INSPECAO ULTRASONICA DE MANCAIS PARA VERIFICACAO DA ADERENCIA METAL-BASE DE ACO]
L. X. Nepomuceno and M. F. Barbosa 6 Jul. 1967 8 p refs In PORTUGUESE; ENGLISH summary
(TN-6707.292)

The method, equipment, and accessories used in the ultrasonic inspection of large metallic bearings for the evaluation of bonding are described. The results are presented in drawing form, indicating the places where there was no bonding between babbit and the steel base. Author

N68-11487* Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
STUDY OF A CLUTCH OPERATED POWER SCREW ACTUATOR FOR SPACE APPLICATION. PHASE I: A SURVEY OF COMMERCIALLY AVAILABLE CLUTCHES Final Report, Mar. 1965–May 1967
Eugene Harrison May 1967 229 p refs
(Contract NAS8-20071)
(NASA-CR-90346) CFSTI: $3.00 CSCL 13I

The clutches are classified according to task, torque capacity, type, design, and actuation. The tasks are identified as on–off coupling, overload, overrunning, speed engagement, and special tasks. The types of clutches are friction, wrap spring, positive engagement, wedging, eddy current, hysteresis, magnetic particle, fluid couplings, and torque converters. The integral types of actuators designated are electromagnetic, hydraulic, and pneumatic. Brief descriptions of each class are given, and the data on each clutch are tabulated. N.E.N.

N68-11527*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO SPACECRAFT RELIABILITY PROGRAM CONTROL—AN IMPORTANT ASPECT IN MAINTAINING A BALANCED RELIABILITY PROGRAM
J. H. Levine [1967] 21 p
(NASA-TM-X-60662) CFSTI: HC $3.00/MF $0.65 CSCL 14D

The paper outlines reliability program control methods relating to reliability task derivation, organizational reliability responsibilities, reliability milestones, reliability organization manning, and the concept of closed-loop management control systems for task implementation. Methods and techniques are discussed with particular attention to the Apollo spacecraft reliability program. Typical problems encountered in the Apollo spacecraft reliability program are briefly discussed. Author

N68-11596# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAKING BIMETAL STRIPS WITH ALUMINUM–TIN ALLOYS

K. M. Rakov 31 Mar. 1967 17 p refs Transl. into ENGLISH from Tsvetn. Metally i Splavy Dlya Zheleznodorozhnogo Transp. (USSR), no. 277, 1964 p 72–81
(Contract AF 33(657)-14782)
(FTD-HT-67-246; TT-67-63247; AD-660416)

The object of this article is the study of development of a technique for obtaining bimetallic bands (alloy A9-1 (A20-1) - Armco iron) and its industrial testing. Steel plating, metal rolling, and aluminum-tin alloys are discussed. There are two basic schemes for obtaining bimetallic aluminum-tin alloy-steel (Armco iron) bands. These are discussed and disadvantages and advantages of each are listed. TAB

N68-11605 Joint Publications Research Service, Washington, D. C.
ACHIEVEMENTS AND TASKS OF TECHNICAL MECHANICS IN METALLURGY AND MECHANICAL ENGINEERING
Lazzlo Gillemot *In its* Rept. of the Tech. Sci. Dept. of the Hung. Acad. of Sci. 30 Nov. 1967 p 62–78 (See N68-11601 02-34)

State and industrial research institutes and actual factory laboratory efforts related to metallurgy and mechanical engineering are summarized. Elasticity and plasticity efforts of a preliminary nature are noted; and plastic deformation technologies are discussed. Materials testing research is described under the headings of plastic and brittle fracture theory, material fatigue, creep phenomena, and effect of speed on stability characteristics. Kinetics and mechanical tasks as well as fluid and gas mechanics efforts are summarized. M.W.R.

N68-11659 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
AN APPARATUS FOR THE PRECISION APPLICATION OF LINERS TO SMALL MOTORS
C. J. Shea and M. Verreault Aug. 1967 17 p refs
(CARDE-TN-1762/67) CFSTI: $3.00

Details of an apparatus and the procedure for the lining of small motor casings are presented. Liner uniformity has been shown to be ±.002 inch, and the precision with which coating thicknesses can be reproduced is at least ±.003 inch. This technique should be suitable for the lining of small tubes and projectiles where a thin uniform coating is required. Author

N68-11697 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF THE STRUCTURAL COMPONENTS OF C-45 AIRCRAFT OPERATED BY FORCA AEREA BRASILEIRA [INSPECAO ULTRA-SONICA DAS TRELICAS DOS AVIOES C-45 OPERADOS PELA FORCA AEREA BRASILEIRA]
L. X. Nepomuceno 29 Mar. 1967 15 p In SPANISH; ENGLISH summary
(TR-6703.286)

The methods, equipment and accessories and the procedure adopted in the ultrasonic inspection of C-45 aircraft structural components are described. The results are presented in schematic drawing and photos of the observed echograms. Author

N68-11700 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF HIGH QUALITY STEEL SHEETS AND PLATES [INSPECAO ULTRA-SONICA DE CHAPAS DE ACO DE ALTA QUALIDADE]
L. X. Nepomuceno, W. Visentini and M. F. Barbosa 5 Sep. 1966 23 p In PORTUGUESE; ENGLISH summary
(TN-6608.263)

The method and procedures adopted, the equipment and accessories used in the ultrasonic inspection of a lot of steel sheets and plates are described. The results are presented indicating the localization of defects, including photographs of the echograms observed. Author

N68-11779 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF FORGED STEEL CYLINDERS [INSPECAO ULTRA-SONICA DE CILINDROS DE ACO FORJADO]
L. X. Nepomuceno and M. F. Barbosa 25 Mar. 1967 19 p In PORTUGUESE; ENGLISH summary
(TR-6703.285)

This report describes the equipment and methods adopted for ultrasonic inspection of a set of heavy forged steel cylinders. The results are presented in drawing schemes, indicating the positioning of the detected flaws and photos of the observed echograms. Author

N68-11790 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC THICKNESS MEASUREMENT IN A 3.000 m^3 BALLOON FOR CORROSION CONTROL [SONDAGEM ULTRA-SONICA DAS PAREDES DE DEPOSITO DE GAS DE 3.000 m^3 PARA CONTROLE DA CORROSAO]
L. X. Nepomuceno and M. F. Barbosa 31 Mar. 1967 9 p In PORTUGUESE; ENGLISH summary
(TR-6703.287)

The report describes the method adopted, equipment and accessories used in the ultrasonic wall thickness measurement of a 3.000 m^3 gas balloon storage, for the control of corrosion. The results are presented in drawing form, indicating the thickness observed and also photos of the echograms. Author

N68-11815 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF 8182 CYLINDERS OF KRS HIGH PRESSURE PUMP [INSPECAO ULTRA-SONICA DO CILINDRO 8182 DA BOMBA KRS]
L. X. Nepomuceno and M. F. Barbosa 29 Jul. 1966 15 p In PORTUGUESE; ENGLISH summary
(TN-6607.256)

The method adopted, and equipment and accessories used in the ultrasonic inspection of high pressure pump parts of cast iron are described. The results are presented in drawings, along with photographs of the reflectograms observed. Author

N68-11816 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF 8182 CYLINDERS OF KRS HIGH PRESSURE PUMP [INSPECAO ULTRA-SONICA DO CILINDRO 8182 DA BOMBA KRS]
L. X. Nepomuceno and M. F. Barbosa 29 Jul. 1966 17 p In PORTUGUESE; ENGLISH summary For abstract see N68-11815
(TN-6607.257)

N68-11817 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF 8182 CYLINDERS OF KRS HIGH PRESSURE PUMP [INSPECAO ULTRA-SONICA DO CILINDRO 8182 DA BOMBA KRS]
L. X. Nepomuceno and M. F. Barbosa 29 Jul. 1966 14 p In PORTUGUESE; ENGLISH summary For abstract see N68-11815
(TN-6607.258)

N68-11822 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF L AND T WELDS IN CCN-012—MARIO D'ALMEIDA SHIP [INSPECAO ULTRA-SONICA DA SOLDAGEM DO TRINCANIS DO NAVIO CCN-012—MARIO D'ALMEIDA]

L. X. Nepomuceno and M. F. Barbosa 1 Mar. 1967 45 p In PORTUGUESE; ENGLISH summary
(TN-6702.284)

The problem; the method and equipment with accessories; and the positioning of the observed defects in the weldments according to the different zones established by the shipyard, are described. The results are presented with schematic drawings illustrating the defects, along with photographs of the observed echograms. Author

N68-11823 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF SPECIAL QUALITY STEEL PLATES TYPE ASTM A-204 GR B [INSPECAO ULTRASONICA DE CHAPAS DE ACO DE ALTA QUALIDADE TIPO ASTM A-204, GR B]
L. X. Nepomuceno, M. F. Barbosa, E. W. Visentini 6 Oct. 1966 10 p In PORTUGUESE; ENGLISH summary
(TN-6610.271)

The method adopted, and the equipment and accessories used in the ultrasonic inspection of a set of special quality steel plates are described. The results are presented in schematic drawings indicating the defects, along with photographs of the observed echograms. Author

N68-11824 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF HIGH QUALITY STEEL SHEETS AND PLATES [INSPECAO ULTRA-SONICA DE CHAPAS DE ACO DE ALTA QUALIDADE]
L. X. Nepomuceno, W. Visentini, and M. F. Barbosa 5 Sep. 1966 18 p In PORTUGUESE; ENGLISH summary For abstract see N68-11700
(TN-6608.263)

N68-11856 Technische Hochschule München (West Germany).
THE DEGREE AND THE NATURE OF THE IMPACT FORCE OF THE ENGAGEMENT OF THE SPROCKET CHAIN OF THE STEEL-PLATE APRON CONVEYOR IN THE SPROCKET WHEEL [DIE GROESSE UND DER VERLAUF DER STOSSKRAFT BEIM EINGRIFF DER LASCHENKETTE VON STAHLGLIEDERBAENDERN IN DAS KETTENRAD]
Guenter Haertlein (Ph.D. Thesis) [1967] 27 p refs In GERMAN

Theoretically, the impact process is treated as a self-vibration of the affected masses. For this purpose, the masses of sprocket wheel, chain, and in case of the steel-link conveyor additionally the masses of the trough and the transported load, are reduced to coincide with the effective direction of the impact force. Also, the elastic deformations of sprocket wheel and chain are used as a base for calculating elasticity values that can be merged into the effective direction of impact. The impact process of the chain drive is calculated as a self-vibration of a two-mass system (as a three-mass system in case of the steel-link conveyor). Force and nature of the impact are measured in model experiments. A comparison of theoretical and experimental results shows a linear dependence of the maximum impact force on the angular velocity of the sprocket wheel. Agreement of the results is good. Transl. by K.W.

N68-11879 Technische Hochschule Hannover (West Germany).
ROTOR POWER USING SCREW PUMPS [LAEUFERKRAEFTE BEI SCHRAUBENPUMPEN]
Friedrich Wilhelm Hamelberg (Ph.D. Thesis) 1966 143 p refs In GERMAN
CFSTI: $3.00

Calculations and pressure distribution measurements on rotary screw pumps, working with water or with oil media, showed that damping components and shaft load-deflections in either the x,z level or the y,z level depended on the outer radius of the rotor, the screw pitch, and the internal construction geometry of the pump. Transl. by G.G.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-11060# Army Missile Command, Huntsville, Ala. Plasma Physics Branch.
EXPERIMENTAL DEVELOPMENT N_2CO_2 LASERS
T. G. Roberts, G. J. Hutcheson, J. J. Ehrlich, and W. L. Hales Jul. 1967 39 p refs
(RR-TR-67-11; AD-659767)

Recent techniques investigated in the Army Missile Commands N2-He-CO2 laser program have produced several lasers with output powers in excess of 100 W/m and efficiencies greater than 25 percent. Scaling laws, various discharge configurations, gas mixtures, optical components, and spectra of the output radiation and of the discharges were studied in attempts to determine the optimum operating characteristics and to produce a better understanding of the mechanisms which make these molecular lasers so efficient. This information was used to design and construct an N2-He-CO2 laser, 180 ft long, which operates in the multikilowatt range with efficiencies and powers per unit length comparable to the smaller lasers of similar construction. This laser was constructed in modular form, each module being approximately 10 ft long. The design and operating characteristics of these lasers are discussed, and the performance data obtained as a function of length each time a module was added are presented. Author (TAB)

N68-11081# Cornell Univ., Ithaca, N. Y. Materials Science Center.
STIMULATED RAMAN EMISSION AND SELF-FOCUSING OF A LASER BEAM IN NON-LINEAR MEDIA
Satish Chand Abbi (M.S. Thesis) Jun. 1967 81 p refs
(Contract Nonr-401(47))
(TR-16; AD-660031)

Stimulated Raman emission and self-trapping of optical beams in non-linear media are two distinct processes. The experiments reported in the paper are aimed at providing some additional experimental material prior to such a combined study of the two processes. The study gives an experimental investigation of stimulated Raman emission in the presence of self-focusing for several liquids. A theoretical treatment is given for the stimulated Raman emission and the self-focusing of intense optical beams. Author (TAB)

N68-11215# Naval Ship Research and Development Center, Washington, D. C. Marine Engineering Lab.
THE DEVELOPMENT OF A LASER CALIBRATION SYSTEM FOR VIBRATION TRANSDUCERS
Patrick O. Prendergast and Patricia Mahalic Oct. 1967 26 p refs
(NSRDC-2454; AD-659975)

Progress to date on the development of a laser interferometer system to be used to calibrate vibration transducers is presented. The theoretical approach to the problem is discussed and the physical setup described, along with modifications imposed by problems encountered. Author (TAB)

N68-11389# Catholic Univ. of America, Washington, D. C.
ELECTRON EXCITATION AND IONIZATION RATE COEFFICIENTS, AND THE RATE OF ENERGY LOSS TO THE VIBRATIONAL LEVELS. APPLICATION TO THE NITROGEN MOLECULE Final Report
A. W. Ali and A. D. Anderson Washington NRL 12 Jul. 1967 17 p refs
(Contract N00014-66-C-0043)
(NRL-6571; AD-659954)

A general expression is given for the calculations of electron excitation or ionization rate coefficients using reliably measured cross sections. This method is then applied to the nitrogen molecule, where the cross section for the excitation of C3pi(v = 0) and the ionization are used to obtain the respective rate coefficients as functions of the electron temperature. In addition, the rate of the energy loss, by electrons, to the ground state vibrational levels of the nitrogen molecule is also calculated using an expression obtained for such a loss rate. Author (TAB)

N68-11575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED SPECTROSCOPY Selected Articles
3 May 1967 18 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSSR (Minsk), v. 5, no. 1, 1966 p 31–35, 118
(Contract AF 33(657)-16408)
(FTD-HT-67-3; TT-67-63252; AD-660440)

The document is comprised of 2 papers. The first reports results of an experimental investigation of processes associated with the presence of an absorbing medium in a laser resonator. It is shown that the behavior of the absorbing medium as a quality modulator depends on its optical parameters in particular on the quantum output of radiative transitions. In the second paper, a method is proposed to separate the channel and the torch of a spark discharge. The method is based on the use of electrodes of a special form. TAB

N68-11765# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
CONTINUOUS-WAVE STIMULATED RAMAN EMISSION Final Report
Marvin C. Tobin and Joseph J. Barrett 30 Jun. 1967 13 p refs
(Contract Nonr-4847(00); ARPA Order 306)
(Rept.-8581; AD-660212)

The goal of the program was the elucidation of discrepancies between gains for stimulated Raman emission calculated from Q-switch laser experiments and those calculated from spontaneous Raman scattering cross-sections and line widths. Two lines of approach were followed. One approach was a study to explore beam trapping by extensive theoretical and limited experimental means. The second was an attempt to measure the gain for stimulated Raman emission, at very low fields, with a continuous-wave argon laser. The conclusions were that beam-trapping was responsible for the observed anomalous gains and that no anomalous gain was present at low fields. TAB

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-11017# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
RADIATION-ENHANCED OXIDATION OF ZIRCALOY-2 IN pH-10 LiOH AND pH-10 NH_4OH
A. B. Johnson, Jr. and J. E. Irvin Jul. 1967 49 p refs
(Contract AT(45-1)-1830)
(BNWL-463) CFSTI: HC $3.00/MF $0.65

Pronounced neutron-flux-induced oxidation occurred on all Zircaloy-2 specimens exposed at 280°C in pH 10 LiOH. Rates up to 3 mg/dm^2 day were observed. A linear relation was observed between in-flux weight gain and fast neutron fluence. Marked differences in susceptibility to flux-induced oxidation and hydriding occurred for the three Zircaloy-2 lots. The highest oxidation rate was accompanied by the lowest rate of H_2 absorption. G-7 loop specimens transferred from pH 10 LiOH to pH 10 NH_4OH continued to oxidize at rates characteristic of the lithiated system. However, the transfer caused more H_2 absorption than that predicted from trends established in the lithiated system. NSA

N68-11040 National Engineering Lab., Glasgow (Scotland).
THE RATE OF GROWTH OF FATIGUE CRACKS IN VARIOUS ALUMINIUM ALLOYS
N. E. Frost and K. Denton Dec. 1966 59 p refs
(NEL-260)

In an attempt to relate the crack growth characteristics of various aluminum alloys to those of the base metal, fatigue tests were made on commercially pure aluminum and five different aluminum alloys. Utilized were sheet specimen 10 inches wide and approximately 1/8 inch thick with each containing a small central slit. Measurements of the growth of the fatigue cracks initiated by the slit were made. Results confirm the assumption that the rate of growth of a fatigue crack in an aluminum alloy is faster (at a given stress cycle and crack length) than in the base metal because alloying introduces inherent sources of fast fractures which give rise to spasmodic elements of fast fracture during the growth process. S.C.W.

N68-11135 British Non-Ferrous Metals Research Association, London (England).
THE CREEP PROPERTIES OF MOLYBDENUM AT 650–750°C Final Report
J. E. Bowers, R. D. S. Lushey, and P. W. J. Sansom Risley, Engl. United Kingdom Atomic Energy Authority 1967 28 p ref
(Contract CON/TRG/160888)
(TRG-1550(C/X); BNFMRA/RR/A1625) HMSO: 5s 6d

Pure molybdenum sheets, 0.04 in. thick, prepared from both arc cast ingot and sintered slab were creep tested at 650 and 750°C. For each material tests were done on both recrystallised strip and samples given a stress-relieving (recovery) anneal. Sheet made from sintered stock had a better creep resistance than that made from arc melted material. Author

N68-11153# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
THE EFFECTS OF FAULTING ON 110 AND 321 PLANES OF A B.C.C. STRUCTURE ON THE DIFFRACTION PATTERN
J. B. Cohen and R. L. Rothman 13 Oct. 1967 37 p refs
(Contract Nonr-1228(20))
(TR-11; AD-660368)

The equations for the effects on the diffraction pattern of stacking faults on (110) and (321) planes of a b.c.c. structure are derived and compared to previous results for faults on (211) planes. As the anomalous broadening of peaks is essentially the same for all three fault planes for the first three peaks, previous studies of line broadening do not clearly delineate on what plane the faults lie, with the exception of metals for which there are

apparently no faults. Problems in analyzing the pattern for these various faults are discussed. The derivations are actually carried out for a CsCl structure to include the effect of antiphase domains produced by slip on the superstructure peaks. Unlike stacking faults, such domain boundaries do not introduce any unusual changes in broadening from peak to peak. Neither faults nor domain boundaries produce any peak shifts in powder patterns. Author (TAB)

N68-11269# General Electric Co., Philadelphia, Pa. Missile and Space Div.

INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Progress Report, Apr. 18-Jul. 18, 1967

M. J. Noone and Willard H. Sutton Watertown, Mass. Army Mater. and Mech. Res. Center 18 Jul. 1967 23 p refs
(Contract DA-19-066-AMC-330(X))
(AMMRC-CR-66-01/5; PR-5; AD-659802)

The work is part of a continuing study to determine the effects of various additives on the wetting and bonding of nickel and nickel alloys to single crystal sapphire (alpha-Al2O3). Single crystal sapphire rods were obtained, their strength measured, and single-fiber composite specimens were fabricated. In order to apply the results directly to the behaviour of whisker composites, it is essential that rods used in future work should have high strength; therefore, a flame-polishing rig was constructed and a polishing technique is being developed. Author (TAB)

N68-11302# Naval Research Lab., Washington, D. C.

ARPA COUPLING PROGRAM ON STRESS-CORROSION CRACKING

E. P. Dahlberg, ed. Aug. 1967 77 p refs
(ARPA Order 878)
(NRL-Memo-1812; QR-3; AD-659958)

A progress report of the research investigations being carried out on the problem of stress-corrosion cracking of high strength materials is presented. Work at Carnegie-Mellon University, Lehigh University, Georgia Institute of Technology, The Boeing Company, and the Naval Research Laboratory concerning physical metallurgy, surface chemistry, fracture mechanics, and characterization tests and translation related to stress-corrosion cracking is described. The materials being studied include high strength steels, titanium alloys, and aluminum alloys. Abstracts of recently published reports and a diary of events are included. Author (TAB)

N68-11312# Pennsylvania State Univ., University Park. Materials Science Lab.

DISPERSED PARTICLE BEHAVIOR IN TD-NICKEL ALLOY

Maurice C. Inman Jun. 1967 14 p refs
(Grant-AF-AFOSR-669-66)
(AFOSR-67-1577; AD-660135)

The progress report describes substructural studies of nickel strengthened with two volume percent thorium oxide (TD-Nickel). Attention is directed to the value of electron transmission techniques for quantitative study of particle size, size distributions and volume fraction. Electron microscope dark field studies show that individual dispersed particles are single crystals. It is found that agglomeration increases with successive cycles of cold work, recovery and recrystallization, and the dispersion also begins to coarsen after long anneal periods at 1400C. Both these processes can lead to degradation of the mechanical properties. Author (TAB)

N68-11348# New York Univ., N. Y. Research Div.

DEVELOPMENT OF TOUGH, HIGH STRENGTH ALPHA-BETA TITANIUM-BASE ALLOYS AT 240,000-260,000 PSI YIELD STRENGTH LEVEL 2 Interim Technical Report, Feb. 1966-Jul. 1967

Paul A. Farrar and H. Margolin Jul. 1967 71 p refs
(Contract DA-19-066-AMC-319(X))
(AMMRC-TR-67-01/1; ITR-1; AD-660299)

In order to develop titanium alloys with 0.1% yield strength in the range 240,000-260,000 psi, a series of 31 eight-pound alloys are being prepared. Melting, testing and forging of 24 eight-pound ingots has been completed, and the data are tabulated herein. Following melting, the three 80 lb. ingots will be tested as sheet, bar stock and upset disks. Weldability studies are to be performed on the sheet material. The compositions of the three 80 lb. ingots were selected and the ingots are being melted. Author (TAB)

N68-11359# Naval Radiological Defense Lab., San Francisco, Calif.

SEAWATER CORROSION STUDIES OF EMISSIVELY-COATED HAYNES 25: RADIOACTIVE TRACER TECHNIQUES

Donald A. Kubose, Harry A. Goya, Ming G. Lai, and Herman I. Cordova 19 Aug. 1967 28 p refs
(Contract AT(49-5)-2084)
(USNRDL-TR-67-109; AD-659978)

Corrosion rates of uncoated, half- and completely-emissively-coated Haynes 25 have been measured in seawater by use of radioactive tracer techniques. The corrosion rates observed for the (1) uncoated and (2) half- and completely-coated specimens were nominally 0.000003 and 0.0001 mil per year (mpy), respectively. It was established that the observed corrosion rates of the half- and completely-coated specimens were due entirely to corrosion of Haynes 25 and not to the corrosion of the emissive coating. The higher corrosion rates were attributed primarily to the fact that the actual surface area of the Haynes 25 was much larger than the geometric surface area because of surface preparation prior to application of the emissive coating. A re-examination of the corrosion rate based upon the amounts of cobalt and chromium released to the seawater indicated that the previously reported differential leaching of these components of Haynes 25 was an experimental artifact due to errors in counting extremely low amounts of chromium-51. Present observations show that the cobalt-and-chromium-based corrosion rates are the same and agree with the previous cobalt-based corrosion rate. Author (TAB)

N68-11429# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

TROPICAL EXPOSURE OF FINISHING SYSTEMS FOR ALUMINUM AND MAGNESIUM

Melvin H. Sandler and Merrill Cohen Sep. 1967 61 p refs
(CCL-233; AD-660358)

The report covers a study of the corrosion resistance provided by specification finishing systems to aluminum and magnesium exposed in a tropical environment. These systems include chemical, anodic, and wash primer metal pretreatments and primers specified for these metals in Military Standard No. 171 Finishing of Metal and Wood Surfaces; several other specification primers that have been used for these metals and an experimental epoxy primer. Finish coats included specification lustreless, semi-gloss, and gloss alkyd resin enamels and gloss polyamide-epoxy enamel. Test specimens were exposed in the Panama Canal Zone at rain forest and sea coast sites. After 28 months exposure, data show numerous specification finishing systems are available to provide corrosion resistance for aluminum and magnesium. The duration of this protection remains to be determined by additional exposure of the more effective systems. Author (TAB)

N68-11477# California Univ., Livermore. Lawrence Radiation Lab.

PROPERTIES OF MULBERRY

H. D. Weiss 28 Jul. 1967 26 p refs
(Contract W-7405-ENG-48)
(UCID-15170) CFSTI: HC $3.00/MF $0.65

Mulberry, a metastable gamma-phase U–Nb–Zr alloy, is described. Physical properties are given; mechanical properties are detailed. Metallurgical characteristics are tabulated. 18 references. NSA

N68-11611*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORROSION PRODUCT OF THE TANTALUM–INTERSTITIAL OXYGEN–POTASSIUM SYSTEM AT 1800°F(1255°K)
C. William Hickam, Jr. Washington Dec. 1967 12 p refs
(NASA-TN-D-4213) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Described herein are the isolation and identification of the corrosion product formed by the exposure of oxygen-doped tantalum to potassium. The corrosion of tantalum by liquid potassium appears to be quantitatively dependent on the oxygen impurity content and to occur by the formation of a ternary oxide. When tantalum containing oxygen in the range of 1600 to 3800 ppm is exposed to potassium at 1800°F (1255°K), depletion of oxygen from tantalum occurs and the hygroscopic potassium tantalate K_3TaO_4 is isolated as the reaction product. These results imply that the total amount of "oxygen-effect" corrosion can be predicted when the total amount of interstitial oxygen in tantalum is known (i.e., oxygen in solution in the metal initially plus oxygen that enters the metal from the environment during the life of the system). Since oxygen-effect corrosion is the most serious type of corrosion encountered by tantalum alloys in contact with potassium at elevated temperatures, the present results are significant for the design and operation of advanced space power systems. Author

N68-11522*# Lockheed-California Co., Burbank.
STRESS CORROSION OF TITANIUM ALLOYS UNDER SIMULATED SUPERSONIC FLIGHT CONDITIONS
K. E. Weber and A. O. Davis Washington NASA Dec. 1967 77 p refs
(Contract NAS1-6361)
(NASA-CR-981) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effects of high altitude supersonic air flow on the titanium hot salt cracking process were studied. Two different types of self-stressed specimens were utilized in these tests; one type was developed by Lockheed and the other by NASA Langley. Specimens were prepared from both the Ti–8Al–1Mo–1V duplex annealed and the Ti–6Al–4V mill annealed alloys. Cracking data from specimens exposed in the wind tunnel were compared to similar data obtained from ordinary laboratory oven tests. The tests demonstrated that the air flow and reduced pressure conditions characteristic of high altitude supersonic flight environments do not eliminate hot salt cracking in these titanium alloys at the test temperatures used in this program. However, cracking in supersonic environments was generally less severe than in laboratory oven environments. As might be expected, some of the salt coating was removed from the specimens by the action of the high velocity air stream, and evidence of a correlation between salt removal and cracking damage was indicated. Author

N68-11604 Joint Publications Research Service, Washington, D. C.
HUNGARIAN TUNGSTEN RESEARCH
Tivadar Millner *In its* Rept. of the Tech. Sci. Dept. of the Hung. Acad. of Sci. 30 Nov. 1967 p 51–61 (See N68-11601 02-34)

The use of trace elements in tungsten filaments is discussed in terms of improved lighting effects, increased lifetime, and high temperature applications; and it is noted that present-day Hungarian tungsten research is primarily concerned with Al, K, and Si three-component additives that assure large crystal structure in drawn out wires that are recrystallized. Electron emission observations of the secondary recrystallization of large crystal tungsten wires are noted, and a general discussion on the effects of additives is included. M.W.R.

N68-11617*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CORROSION OF NIOBIUM-1% ZIRCONIUM ALLOY AND YTTRIA BY LITHIUM AT HIGH FLOW VELOCITIES
L. G. Hays 1 Dec. 1967 35 p refs
(Contract NAS7-100)
(NASA-CR-90513; JPL-TR-32-1233) CFSTI: $3.00 CSCL 11F

An experiment was performed to measure the material removal from two materials—niobium-1% zirconium alloy and yttrium oxide—by a lithium stream flowing at a maximum velocity of 48.5 m/s. After 109 hr at 1143°C, the yttria specimens were completely dissolved. After an additional 391 hr at 1073°C, the maximum depth of material removal from the niobium alloy was measured to be about 7 μm. This value corresponds to the depth calculated from turbulent mass-transfer relations for simple dissolution if the temperature coefficient of solubility is taken to be 1.2×10^{-9} g Nb/g Li °C. The measured variation of material loss with lithium velocity follows the dependency predicted by these relations, indicating a diffusion-limited process. Author

N68-11637* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE OF LIQUID ROCKET ENGINE METALS AT CRYOGENIC TEMPERATURES TO −452°F (4°K)
Alfred J. Nachtigall, Stanley J. Klima, and John C. Freche Washington Dec. 1967 54 p refs
(NASA-TN-D-4274) CFSTI: $3.00 CSCL 11F

Axial tensile fatigue behavior of four candidate alloys for liquid rocket engines was investigated for smooth and notched (theoretical stress concentration factors $K_t > 17$) sheet specimens at a minimum-to-maximum cyclic stress ratio R of 0.14 in ambient air (70°F, 294°K), liquid nitrogen (−320°F, 77°K), and liquid helium (−452°F, 4°K). The materials tested were 2014-T6 aluminum alloy, Inconel 718, 5 percent aluminum–2.5 percent tin–titanium (5Al–2.5Sn–Ti) alloy, and AISI 301 stainless steel. The fatigue strength of smooth specimens was generally higher than that of notched specimens. Except for AISI 301 stainless steel the fatigue strength of unnotched specimens increased progressively with decreasing test temperature to −452°F (4°K). This trend was also observed for 2014-T6 aluminum alloy and Inconel 718 in the notched condition. In most instances, Inconel 718 and 301 stainless steel had the highest fatigue strength while the 5Al–2.5Sn–titanium and 2014-T6 aluminum alloys ranked third and fourth. The titanium alloy generally had the highest fatigue-strength-to-density ratio at all temperatures. The fatigue notch factor K_f increased with cyclic life for all materials at all test temperatures. Up to 100 cycles, the increase was small, and the fatigue notch factor was essentially equal to the tensile notch factor (ratio of smooth specimen tensile strength to notched specimen tensile strength). Inconel 718 generally had the lowest K_f over the life range considered at all temperatures. Author

N68-11644*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEPOSITION OF SPUTTERED MOLYBDENUM DISULFIDE FILMS AND FRICTION CHARACTERISTICS OF SUCH FILMS IN VACUUM
Talivaldis Spalvins and Hohn S. Przybyszewski Washington Dec. 1967 14 p refs
(NASA-TN-D-4269) CFSTI: HC $3.00/MF $0.65 CSCL 11H

Physical direct-current sputtering of molybdenum disulfide (MoS_2) is used to apply MoS_2 films as a solid lubricant for

rotating and sliding components. This method does not use organic or inorganic binders or the process of burnishing. Friction experiments in vacuum (10^{-11} torr or 1.33×10^{-9} N/m^2) were conducted on these films. The coefficients of friction for the sputtered films were in agreement with the reported values in the literature. Stoichiometric films were obtained, and no dissociation was observed. There is a strong bonding (adherence) between the films and the substrate, as indicated by the long-endurance life of the lubricating films in friction experiments. The sputtered MoS_2 films had an accurate repeatability in terms of stoichiometry, adherence, thickness, and uniformity when the sputtering conditions were kept constant. Author

N68-11650*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

DETERMINATION OF BIAXIAL CREEP STRENGTH OF T-111 TANTALUM ALLOY Semiannual Report, Mar. 8–Sep. 8, 1967

L. B. Engel, Jr., ed. 8 Sep. 1967 31 p refs

(Contract NAS3-9437)

(NASA-CR-72337) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A program is being conducted to determine the creep behavior of seamless and welded and reworked T-111 alloy tubing under a biaxial state of stress, and to evaluate the effects of stress on the corrosion behavior of T-111 alloy with potassium. During this period minor design changes in the test facility were completed. The design of the potassium pressure transducer, to be used in measuring the potassium pressure in the refluxing capsules during testing, was completed. Components of the pressure transducer were machined and its assembly is underway. An error analysis was made of the test facility and the stress–strain relationships used in calculating equivalent uniaxial values from biaxial data. R.N.A.

N68-11803* Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering.

AN X-RAY STUDY OF LOCAL ATOMIC ARRANGEMENTS AND THE EFFECT OF COLD WORK ON SHORT-RANGE ORDER IN A NICKEL-10 ATOMIC PERCENT TUNGSTEN ALLOY

Aubrey Mitchell Ammons (M.S. Thesis) Aug. 1967 81 p refs

(Grant NGR-43-001-018)

(NASA-CR-90508) CFSTI: $3.00 CSCL 11F

The local atomic arrangements in a nickel-10 atomic percent tungsten alloy and the effects of cold work on the degree of short-range order in this alloy were studied. A single crystal was oriented to permit X-ray diffuse scattering measurements. Comparison of the experimental α_{1mn} with values calculated from models led to the conclusion that the short-range structure of the nickel-10 atomic percent tungsten alloy is statistically similar to the structure of long-range ordered Ni_4W. The atomic size effect was relatively small; an estimate of the nearest neighbor size effect coefficient gave $\beta_{110} = 0.009 \pm 0.004$. X-ray diffuse scattering measurements were also made on polycrystalline samples of the nickel alloy as a function of reduction by cold rolling and following recrystallization or recovery treatments. These data showed that cold working decreased the degree of short-range order in the alloy, but there was still some local order remaining after reductions as great as 80%. Most or all of the short-range order destroyed by cold working could be recovered by annealing the samples at temperatures (near 600°C) below that necessary for recrystallization. Cold work and annealing treatments were followed by electrical resistivity measurements. Author

N68-11866# AiResearch Mfg. Co., Los Angeles, Calif.

INVESTIGATION OF MATERIALS TO RESIST HOT CORROSION IN SMALL GAS TURBINE ENGINE RECUPERATORS Quarterly Report

W. Larson, G. Gurbishley, and O. Jones Sep. 1967 35 p refs

(Contract DAAJ02-67-C-0048)

(HT-67-2512-1; AD-659811)

The initial tasks of this program was to select and order materials which will be used to produce good samples of tube-to-header joints for a dynamic hot corrosion test. To accomplish this objective, published research reports and physical properties of the materials being considered were reviewed. The selection was made by evaluating each material on the basis of the following criteria: (1) Fabrication, (2) Hot-corrosion resistance, (3) Mechanical properties and relative costs. TAB

N68-11872* General Electric Co., Philadelphia, Pa. Missile and Space Div.

INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS DISCONTINUOUS, BRITTLE FIBERS Final Report

A. Gatti, J. M. Berry, J. J. Gebhardt, J. Mullin, and E. Feingold Nov. 1967 117 p refs

(Contract NASw-1543)

(NASA-CR-90526; Rept.-214-2E2) CFSTI: $3.00 CSCL 11F

A critical assessment is made of the factors affecting the reinforcement of aluminum, aluminum alloys, and ductile epoxies with short brittle fibers such as B_4C whiskers, or with high modulus filaments such as B_4C/B/W, SiC/W, or B/W. Consideration is also given to the development of a more economical process for growing B_4C whiskers, deposition parameters, the production of continuous B_4C fibers, and the characterization of the individual constituents in the final composites. The following conclusions are among those reported: (1) The chemical vapor deposition process produced only poorly defined B_4C whiskers. (2) Aluminum powder processing can produce single filament tensile specimens similar to those achieved by using a hot-pressed sheet and tube method. (3) The fracture mode, strength, and ductility of single filament epoxy composites are markedly affected by the strain rate and prior strain history of the specimens. (4) For brittle filaments of high average strength and high strength scatter, composite strength may be less than that predicted by the rule of mixtures, owing to premature matrix failure. M.G.J.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-11013*# Rensselaer Polytechnic Inst., Troy, N. Y.

SEMIANNUAL PROGRESS REPORT, SEPTEMBER 1, 1966–FEBRUARY 28, 1967

Mar. 1967 20 p refs

(Grant NsG-100-60)

(NASA-CR-90231; SAPR-12) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Brief reports are presented on continuing research investigations on materials and techniques. The following include the general areas of study: polymers; pyrolytic materials, solidification mechanisms, stress corrosion, and dissolution of metals; glass and nonmetallics; inorganic coordination compounds; dispersion strengthened alloys; ultrasonics, low temperature physics, X-ray scattering, and electron spin resonance. N.E.N.

N68-11131# Prodesco, Inc., Perkasie, Pa.
DEVELOPMENT OF HIGH INTENSITY THERMAL PROTECTIVE FABRIC
Hal E. Brockman and Robert Donnelly Johnsville, Pa., Naval Air Develop. Center 8 Aug. 1967 42 p refs
(Contract N62269-3129)
(NADC-MR-6715; AD-659974)

The development of a fabric that would be protective against high-intensity thermal energy was approached using three criteria, the first being that the majority of the fiber in the fabric be a textile material. After evaluating various fibers, Nomex was determined to be the primary fiber for this structure. The second parameter examined was that of a known spacing between two layers of fabric studied in various ways. The final concept arrived at was a two-layer fabric that was intimately tied together at 3/8 inch intervals. The third effort was directed toward finding a fibrous material that would absorb or distribute the thermal energy within the fabric itself. Of the many metallic and inorganic materials evaluated, a slit aluminum foil/Mylar film yarn was considered to be the optimum structure for its weight and bulk. The fabric developed from this fiber and structure evaluation was a 7.3 oz/sq yd two-layer Nomex fabric tied together at intervals, either with or without a slit aluminum scrim between the two layers.
Author (TAB)

N68-11161# General Precision, Inc., Little Falls, N. J. Aerospace Group.
STUDY OF MICROMECHANICAL PROPERTIES OF ADHESIVE BONDED JOINTS Quarterly Progress Report, 30 Jun.–30 Sep. 1967
Michael C. Franzblau and John L. Rutherford 15 Oct. 1967 42 p refs
(Contract DAAA21-67-C-0500)
(QPR-1; AD-660277)

The effective tensile modulus of adhesives in thin film bonded form was found to be dependent on thickness. For an epoxy-polyamide adhesive system, the effective tensile modulus increased from 520,000 psi at a bond thickness of 0.040 inch to 640,000 psi at a thickness of 0.001 inch. In the same system, the fracture stress sharply increased at bond thicknesses less than about 0.010 inches; reaching 12,000 psi for a bond thickness of less than 0.0001 inch. The shear modulus of this adhesive appears to decrease when loaded to higher stresses; in addition, there is evidence of 'work-hardening'. Preliminary work was begun on a postulate of an interfacial layer in the adhesive that has different properties than the interior of the material. As part of a separate program, the frequency dependence of the dissipation factor was measured for selected adhesive systems. It was found that there is little correlation between the mechanical properties of bulk cured polymers and the same material in thin film form in a bonded joint. For example, the effective tensile modulus is increased in thin film joints and the fracture stress has been found to increase as the bond thickness is decreased.
TAB

N68-11270# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
EFFECTS OF SURFACE TREATMENTS ON BONDING TO POLYETHYLENE WITH VARIOUS TYPE ADHESIVES
A. Devine, W. Bodnar, E. Duda, and M. Bodnar Oct. 1967 14 p
(PA-TM-1797; AD-660276)

Six surface treatments were investigated to determine what benefits they afforded in adhesive bonding to polyethylene. Three different types of polymeric adhesive systems--epoxy, polyester, and nitrile-phenolic--were used with each surface treatment in order to make a better assessment of the treatment and to determine if the same relative results were obtainable within each adhesive system. Best overall bonds were obtained with the epoxy adhesive. In all cases, the surface treatments used prior to bonding resulted in improved bond strengths over the untreated control. The effectiveness of the surface treatments tested, in descending qualitative order, are as follows: Flame treated; Acid treated, rinsed, acetone dried; Acid treated, rinsed, wiped and air dried at 23C; Acid treated, rinsed, oven dried at 71C; Acid treated, rinsed, oven dried at 90C; Sanded.
Author (TAB)

N68-11288# California Univ., Livermore. Lawrence Radiation Lab.
CORRELATION OF HEAT OF FUSION AND OPTICAL DENSITY IN PENTON WITH ABSORBED DOSE USING A PROPOSED SPECTRUM FOR THE XRD-6 X-RAY MACHINE
Barbara J. Mallon May 1967 16 p refs
(Contract W-7405-ENG-48)
(UCRL-50293) CFSTI: HC $3.00/MF $0.65

Penton specimens were exposed to X-rays from the XRD-6 X-ray machine operated at 50 peak kV. Incident fluxes were 25, 50, and 100 cal/cm^2 either unfiltered or with zinc or titanium–aluminum filters. The Penton samples irradiated consisted of layers of 1/2 in.-diam discs in the range of 0.0254- to 0.070-mm thickness so that the radiation damage could be studied as a function of depth as well as dose and energy spectrum. The XRD-6 spectrum proposed by Taylor was used as the basis for calculation of absorbed dose as a function of depth for each exposure.
Author (NSA)

N68-11323 Joint Publications Research Service, Washington, D. C.
ELECTRON MICROSCOPE STUDY OF RADIATION DAMAGE IN BERYLLIUM OXIDE
A. V. Khudyakov, Z. Ye. Ostrovskiy, and V. I. Klimenkov *In its* Spec. Uses of Electron Microscope and Cesium Thermal Emission Converter 14 Nov. 1967 p 10–15 refs (See N68-11321 02-34)

Electron microscope studies were conducted into the formation of porosity during isothermal annealing of BeO irradiated at low temperature to trace the development of helium porosity during various stages, to estimate the influence of various factors on the production and development of porosity, and to make conclusions concerning the mechanism of retention of helium atoms in the BeO lattice. Results show that helium atoms in the BeO lattice are held in vacancy type traps. The activation energy of the processes leading to the formation of pores is about 6 eV. There are two mechanisms for the growth of helium pores during sintering: merging of pores into channels at places where the vancancies are absorbed, and a type of coalescence involving diffusion merging of small pores into large pores in places where simultaneous and even liberation of helium and vacancies occurred. The material has suitable areas for pore generation. Helium pores on the boundaries and within the grains may be looked upon as a basis for further increases in radiation strength of BeO by creating intragranular porosity.
R.N.A.

N68-11413# Rock Island Arsenal Lab., Ill. Research and Engineering Div.
DEVELOPMENT OF A WIDE-TEMPERATURE RANGE HYDRAULIC FLUID
Ralph L. Le Mar Sep. 1967 33 p refs
(RIA-67-2254; AD-660314)

Work was performed to formulate an extreme low temperature hydraulic fluid that would show better physical and chemical stability at high temperatures than do the commonly used low temperature mineral oil based fluids. A synthetic fluid, tetra(2-ethylhexyl) orthosilicate, was selected as a base stock for the fluid. Various chemicals were examined for their effects on the base fluids thermal stability and other properties. These chemicals

included oxidation inhibitors, hydrolysis inhibitors, thickeners, and rubber swell improvers. Thermal stability tests at 700F, showed the silicate fluid to be adversely affected by several frequently used additives. Unreactive, aromatic compounds were found that were compatible with the silicate fluid and also improved its rubber swell properties. A promising blend, No. 7M8, was evolved and evaluated for properties pertinent to hydraulic fluid use. Results indicated that this blends properties were generally as good as or better than those of standard low temperature mineral oil based fluids. An outline of requirements for a Military Specification was prepared. Author (TAB)

N68-11450# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH ON SEMICONDUCTING POLYMERS. 2: IRRADIATED AND HEAT-TREATED POLY(VINYL ACETATE)
Serge Markov *In its* Foreign Sci. Bull., Vol. 3, No. 10 Oct. 1967 p 1–14 refs (See N68-11449 02-34)

A new semiconducting polymer, irradiated and heat-treated poly(vinyl acetate), has recently been developed. The research on this new material has involved preparation, study of its electrical and paramagnetic properties, study of the effect of subsequent irradiation on these properties, and the development of an electrical conduction mechanism. Author

N68-11453# Royal Aircraft Establishment, Farnborough (England).
COMPRESSION SET RESISTANCE IN SILICONE RUBBERS
D. K. Thomas and E. Kay Mar. 1967 17 p refs
(RAE-TR-67075; AD-660329)

It is common practice in silicone rubber technology to give rubber articles a long high temperature post cure in air in order to achieve maximum resistance to compression set. It is proposed that this is necessary to destroy hydroperoxide groups established in the rubber during vulcanization. Systems are described in which maximum resistance to compression set can be achieved without post cure. Author (TAB)

N68-11474*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECTS OF ETHYLENE OXIDE–FREON 12 DECONTAMINATION AND DRY HEAT STERILIZATION PROCEDURES ON POLYMERIC PRODUCTS
S. H. Kalfayan, B. A. Campbell, and R. H. Silver 15 Sep. 1967 59 p refs
(Contract NAS7-100)
(NASA-CR-90429; JPL-TR-32-1160) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The effects of sterilization conditions on a number of products of interest in spacecraft applications are discussed. After classification according to function, the products were subjected to decontamination and dry heat sterilization procedures which consisted of: (1) exposure to ethylene oxide–Freon 12 for six cycles of 28 h each at 50°C and 50% relative humidity; and (2) exposure to dry heat for six cycles of 92 h each at 135°C in dry nitrogen. Extensive testing was performed both before and after exposure to ethylene oxide, and again after dry heat exposure, to determine the changes in the physical, mechanical and electrical properties of the products. The criteria used for rating the compatibility of the products tested with the sterilization environments are presented. Some of the products were also exposed, after ethylene oxide decontamination, to 120°C in nitrogen for six cycles of 250 h each and to 150°C in nitrogen for six cycles of 59 h each. These results are also discussed. Author

N68-11625*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MECHANICAL BEHAVIOR OF TANTALUM CARBIDE AND MAGNESIUM OXIDE
M. H. Leipold and T. H. Nielsen 1 Dec. 1967 14 p refs
(Contract NAS7-100)
(NASA-CR-90511; JPL-TR-32-1201) CFSTI: HC $3.00/MF $0.65 CSCL 11B

Tensile fracture stress data at room temperature are presented for a series of hot-pressed polycrystalline MgO and TaC specimens. An unacceptably large number of failures in the end section of the MgO indicated the need for improved fabrication techniques. Data for the $TaC_{0.93}$ indicate a fracture stress of approximately 25 kg/mm^2 (35,000 psi) and a Young's modulus of 2.8×10^4 to 2.9×10^4 kg/mm^2 (39×10^6 psi). Termination of the program before its completion prevented such inprovement and the generation of sufficient data for constructive analysis. Consequently, data are presented in detail to permit subsequent analysis. Author

N68-11698* General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE EVALUATION OF THE STRENGTH OF FIBER-REINFORCED COMPOSITES
L. S. Shu 5 May 1967 32 p refs Presented at the Intern. Conf. on the Mech. of Composite Mater., Philadelphia, 8–10 May 1967
(Contract NASw-1377)
(NASA-CR-90509; R67SD25) CFSTI: $3.00 CSCL 11D

The strength of unidirectional fiber-reinforced composites is evaluated quantitatively in terms of the strength of their constituents. Methods of limit analysis of plasticity are applied to obtain bounds for the limit loads which characterize the strength. The same technique can be used to evaluate the strength of fibrous composite laminates. Author

N68-11783*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRUCTURE DEPENDENCE OF THE DIAMAGNETISM OF GRAPHITIZING CARBONS
D. B. Fischbach 1 Dec. 1967 16 p refs
(Contract NAS7-100)
(NASA-CR-90546; JPL-TR-32-1208) CFSTI: HC $3.00/MF $0.65 CSCL 11B

Structure dependent sources of the variation in diamagnetic susceptibility values and responses to heat treatment among different graphitizing carbons are investigated in pyrolytic carbons. Two microstructural parameters, the apparent crystallite layer diameter L_a and the interlayer spacing d, are shown to be important. The total diamagnetic susceptibility X_T, which is independent of anisotropy, increases with L_a rapidly in the range below 200 Å and more slowly at higher L_a values. The value X_T also decreases with decreasing d (increasing layer-stacking order). It is shown that these two types of structure dependence can account, at least qualitatively, for much of the magnetic behavior observed in pyrolytic and other graphitizing carbons. Also discussed is the relationship of the electronic structure to the microstructure, which is the source of the observed structure sensitivity. The high susceptibility values of disordered pyrolytic carbons are in excellent agreement with theoretical predictions of the influence of interlayer interactions on the electronic structure. It is concluded that this is the primary source of the observed d dependence. The source of the dependence on L_a is not as well understood. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-11058# Purdue Univ., Lafayette, Ind. Statistics Dept.
ORDER STATISTICS ARISING FROM INDEPENDENT BINOMIAL POPULATIONS
Shanti S. Gupta and S. Panchapakesan Sep. 1967 143 p refs *Its* Ser. No. 120
(Contract AF 33(615)-67-C-1244)
(AD-659164)

This paper deals with order statistics from the binomial distribution. Let X_i (i=1,2,...,M) be the number of successes in N independent trials from a binomial distribution with p as the probability of success, in each trial. Let X_i be arranged in order to give $X_{(1)} \leq X_{(2)} \leq \ldots \leq X_{(M)}$. The discrete variable X_i or $X_{(i)}$ take values 0,1,...,N (i=1,...,M). Tables are provided giving the cumulative distribution and the expected value and variance of $X_{(1)}$ and $X_{(M)}$. Joint distribution of $X_{(i)}$ and $X_{(j)}$ is obtained. The distribution of $X_{(j)} - X_{(i)}$ (j>i) is also derived and special cases are studied. Some applications are described. Author

N68-11066 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON CHARACTERISTIC FUNCTIONS OF FUNCTIONAL OF PROCESSES WITH INDEPENDENT INCREMENTS
B. G. Marchenko 1967 10 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 19, no. 3, 1967 p 29-39

The characteristic function of a process $\zeta(t)$, obtained as a result of application of a linear operator given with the aid of the function $\phi(t)$, to the function $\eta(t)$ belonging to the class of random processes with independent increments, is examined. Two theorems (the one and multidimensional cases) are presented on the characteristic functions of a random vector $(\zeta_1, \zeta_2, \ldots \zeta_n)$ whose components are linear functionals of process having independent increments $\eta(t)$. By applying a metrically transitive group of measure conserving transformations to the components of the vector, the obtained results are extended to the case of the process $\zeta(t)$. Examples in which the theorems are utilized to obtain the characteristic functions of some models whose prototypes are encountered most often in applications of processes with independent increments, are considered. L.S.

N68-11069# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
STOCHASTIC PROGRAMS WITH RECOURSE: SPECIAL FORMS
David W. Walkup and Roger J.-B. Wets Aug. 1967 38 p refs *Its* Math. Note No. 516
(D1-82-0627; AD-660054)

This paper is a sequel to AD-637 139 in which stochastic programs with recourse were formulated as a generalization of the two-stage programming under uncertainty model, and some of the theoretical properties of stochastic programs with recourse were developed. In this paper some special forms of stochastic programs with recourse are considered, which, because they are less general, may prove to be more amenable to computational solution. It is also shown that certain problems studied by other authors, including the active approach of G. Tintner and the conditional probability model of chance constrained programming treated by A. Charnes and M. Kirby, can be represented as stochastic programs with recourse. Author (TAB)

N68-11071# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SOME INEQUALITIES FOR STARSHAPED AND CONVEX FUNCTIONS
Richard E. Barlow (Calif. Univ., Berkeley), Albert W. Marshall, and Frank Proschan Aug. 1967 40 p refs *Its* Math. Note 519
(D1-82-0643; AD-660072)

Necessary and sufficient conditons are obtained on a function G of bounded variation such that phi(integral sign x(t)dG(t)) = or < integral sign phi(x(t))dG(t) for all increasing x for which x(t sub 0) = 0 for some specified t sub 0, and all convex phi for which phi(0) = 0; the conditions are otherwise independent of phi and x. Similar results are obtained when the inequality is reversed. Necessary and sufficient conditions for both directions of inequality are also obtained when phi is starshaped. The relationship to previous results is sketched. Applications to statistical tolerance limits are indicated. Author (TAB)

N68-11076# California Univ., Los Angeles. Western Management Science Inst.
PROPER EFFICIENCY AND THE THEORY OF VECTOR MAXIMIZATION
Arthur M. Geoffrion Aug. 1967 21 p refs Sponsored jointly by USAF Proj. RAND, NSF, and ONR *Its* Working Paper 123
(Contract Nonr-233(75))
(AD-659989)

The concept of efficiency in problems with multiple criterion functions--sometimes under an alias such as admissibility or Pareto optimality--has long played an important role in economics, game theory, statistical decision theory, and in all optimal decision problems with noncomparable criteria. Here we propose a slightly restricted definition of efficiency that eliminates efficient points of a certain anomalous nature. This new definition, which we call proper efficiency, is related in spirit to the notion of proper efficiency introduced by Kuhn and Tucker in their celebrated paper of 1950; but the present definition avoids certain drawbacks inherent in the earlier one. A comprehensive theory of vector maximization is constructed using the new definition, with and without various constraint qualification, convexity, and differentiability assumptions. The theory includes as a special case the standard theory of nonlinear programming. Author (TAB)

N68-11094# Purdue Univ., Lafayette, Ind. Statistics Dept.
SOME RESULTS ON ALMOST SURE AND COMPLETE CONVERGENCE IN THE INDEPENDENT AND MARTINGALE CASES
William Fleming Stout Aug. 1967 72 p refs *Its* Ser. No. 113
(Contract Nonr-1100(26))
(AD-656485)

Some results on the convergence of linear combinations of independent random variables are presented, and various sets of conditions for the complete convergence of T_n to zero are given. The double truncation method of proof is used. Convergence properties of generalized Gaussian random variables are extended to the martingale case, and lemmas are derived to give some elementary properties of generalized Gaussian random variables which are useful in studying their convergence properties. Emphasis is also placed on the martingale structure, and several martingale convergence results are established. A strong law of large numbers for independent random variables is extended to the martingale case, and previous theories are combined to yield a new martingale convergence theorem. An extension of the Kolmogorov law of the iterated logarithm to the martingale case is made. M.G.J.

N68-11103# RAND Corp., Santa Monica, Calif.
FINITE STATE CONTINUOUS TIME MARKOV DECISION PROCESSES WITH AN INFINITE PLANNING HORIZON
Bruce L. Miller Sep. 1967 36 p refs
(Contract F44620-67-C-0045) Proj. RAND)
(RM-5425-PR; AD-659730)

The system considered may be in one of n states at any point in time; its probability law is a Markov process that depends on the policy (control) chosen. The return to the system over a given planning horizon is the integral over that horizon of a return

rate that depends on both the policy and the sample path of the process. The objective is to find a policy that maximizes the expected discounted return as the planning horizon tends to infinity. The case where the discount factor goes to zero is also considered. In all cases it is shown that there is a stationary policy that is optimal, and an algorithm is given to obtain that policy.
Author (TAB)

N68-11109*# Brown Univ., Providence, R. I.
USE OF A TRANSCENDENTAL APPROXIMATION IN TRANSIENT CONDUCTION ANALYSIS
P. D. Richardson and W. W. Smith (Taco, Inc.) Washington NASA Dec. 1967 24 p refs
(Grant NGR-40-002-012)
(NASA-CR-955) CFSTI: HC$3.00/MF$0.65

A particular example of a transient conduction problem with a non-linear boundary condition is considered, for which other solutions have been obtained. This example consists of unsteady one-dimensional conduction in a semi-infinite slab with the boundary condition that the heat flux at the surface is proportional to the n-th power of the surface temperature and with the initial condition that the slab temperature is uniform, forming the reference zero (i.e. the zero of an appropriate empirical temperature scale). Solutions for this form of boundary condition are useful for a variety of problems. One practical problem for which they have been used is transient conduction due to unsteady radiation in an enclosure.
Author

N68-11116# RAND Corp., Santa Monica, Calif.
RECENT COMPUTATIONAL EXPERIENCE WITH THREE CLASSES OF INTEGER LINEAR PROGRAMS
A. M. Geoffrion Oct. 1967 10 p refs
(P-3699; AD-660116)

In AD-655 444 the author presented an implicitly enumerative algorithm for integer linear programming that involves the repeated solution of smaller continuous linear programs. Both primal and dual interpretations of the continuous programs are used in an essential way. The computational experience reported there shows that use of the imbedded linear program dramatically improves a bare bones implicit enumeration procedure, and suggests that the resulting algorithm is significantly more efficient than the previously reported enumerative algorithms for which comparable computational experience is available. This note presents further computational results concerning how fast solution time increases with the number of variables. This question has been investigated in the range of 30-90 variables for three important classes of problems: set covering, optimal routing in networks, and knapsack with several constraints.
TAB

N68-11128# Wisconsin Univ., Madison. Mathematics Research Center.
AN EXTENDED ENERGY INTEGRAL TECHNIQUE FOR LINEAR DIFFERENTIAL EQUATIONS
Abraham Kadish Jul. 1967 21 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF GP-6143)
(MRC-TSR-742; AD-660507)

An extended energy integral technique for boundary value problems is presented for a class of differential equations which are prevalent in mathematical physics. The extended technique provides a method for answering questions in wave propagation and stability which could not be treated by the familiar method of energy integrals.
Author (TAB)

N68-11129# California Univ., Berkeley. Operations Research Center.
AN ALGORITHM FOR INTEGER LINEAR PROGRAMMING BY PARAMETRIC MODIFICATION OF AN ADDED CONSTRAINT
Hajime Eto Aug. 1967 41 p refs
(Contracts Nonr-222(83); DA-31-124-ARO-D-331; Grant NSF GP-7417)
(ORC-67-32; AROD-5307.27-M; AD-660007)

To solve an integer linear program, we identify particular values that the objective function can assume on feasible lattice points. Thus, we reduce the problem of finding an optimal integer solution of n dimensions to that of finding a feasible integer solution of n-1 dimensions. A Branch and Bound Method is presented to solve the latter problem for the 0-1 case.
Author (TAB)

N68-11159# RAND Corp., Santa Monica, Calif.
EVALUATION OF FUNCTIONALS OF SOLUTIONS OF FREDHOLM INTEGRAL EQUATIONS WITH DISPLACEMENT KERNELS
H. H. Kagiwada, R. E. Kalaba, and S. Ueno Oct. 1967 12 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5459-PR; AD-660096)

The report gives a simplified method of evaluating functionals of solutions of Fredholm integral equations using the b and h functions reported in AD-648 506. AD-648 506 showed that all the important functions of multiple scattering could be expressed with ease in terms of the simpler b and h, which represent the internal specific intensities in atmospheres illuminated isotropically from the top (b) or bottom (h). A more generalized mathematical treatment is presented in this study. The functions b and h depend on only three variables, whereas I depends on four, and their use avoids a matrix inversion.
TAB

N68-11180# California Univ., Berkeley. Operations Research Center.
MULTICOMMODITY STEADY STATE INVENTORY MODEL SUBJECT TO LINEAR RESTRICTIONS
Enrique Hueda Sep. 1967 35 p refs
(Contract Nonr-222(83))
(ORC-67-33; AD-660008)

This paper is concerned with (i) the maximization of net return Summation, j = 1 to j = n, of pi sub j (y sub j, t sub j) and, (ii) the maximization of average net return Summation, j = 1 to j = n, of pi sub j (y sub j, t)/t of a deterministic multicommodity system subject to linear restrictions on the inventory levels y sub j and the review periods t sub j (j = 1, ..., n). The first problem is a symmetric quadratic program. For the second problem, an algorithm is given for finding the optimal solution.
Author (TAB)

N68-11204# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE STUDY OF A SINGULAR POINT OF BRIOT-BOUQUET TYPE FOR A SYSTEM OF ORDINARY NONLINEAR DIFFERENTIAL EQUATIONS, 2
Masahiro Iwano Jul. 1967 39 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-760; AD-660601)

The report considers the construction of analytic expressions for bounded general solutions of an equation of the form xy prime = f(x,y) when f subscript y(0,0) is the zero matrix.
TAB

N68-11222# Wisconsin Univ., Madison. Mathematics Research Center.
COLLECTIVELY COMPACT SETS OF GRADIENT MAPPINGS
James W. Daniel Jul. 1967 21 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-758; AD-660504)

Properties of families of functionals whose gradients form collectively compact sets are studied and results are applied to the approximate minimization of functionals. It is shown that under certain conditions limits of points extremizing approximating functionals will extremize the limit functional. Author (TAB)

N68-11229# Technische Hochschule in Wien (Austria). Inst. fuer Numerische Mathematik.

STABILITY REGIONS OF DISCRETE VARIABLE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS

Hans J. Stetter, Werner Baron, and Hildegarde Sochatzy 15 Sep. 1967 33 p refs

(Contract AF 61(052)-960)

(AFOSR-67-2329; SR-1; AD-659798)

The idea of strong stability is the following: The effect of a perturbation in the finite-difference equation should not be worse than the effect of a corresponding perturbation in the differential equation to be solved numerically. For a given discretization scheme, a one-parameter family of regions in the complex domain is defined which permits to test for a given system of differential equations and a given stepsize whether strong stability prevails or not. Furthermore the shapes and sizes of the regions permit a comparison between the stability properties of various schemes. In the present report, a particular effort has been made to investigate the influences of the various alternatives in the algorithmic execution of a predictor-corrector method. The results are displayed in a large number of plots. TAB

N68-11258# Wisconsin Univ., Madison. Mathematics Research Center.

AN OPERATOR METHOD FOR HARMONIC ANALYSIS ON LOCALLY COMPACT ABELIAN GROUP

Hisaharu Umegaki Jun. 1967 53 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-725; AD-660506)

Several fundamental theorems of harmonic analysis on locally compact abelian groups are proved utilizing straightforward methods based on the Gelfand representation of C star-group algebras generated by the regular representation of the L prime-algebra. The main theorems discussed in this note are those of Stone, Bochner, Khinchine, Plancherel and the duality theorem for locally compact abelian group. Author (TAB)

N68-11261# Maryland Univ., College Park.

FUNDAMENTAL RESEARCH IN APPLIED MATHEMATICS Final Report, Jul. 1, 1965–Jun. 30, 1967

M. H. Martin and W. Rheinboldt 30 Jun. 1967 18 p

(Grant DA-ARO(D)-31-124-G676)

(AROD-407-76-M; AD-660352)

The research work of M. H. Martin and students centered around the boundary problem delta u = u subscript xx + u subscript yy = 0 in S, u subscript n = h(s)f(u,v), for an analytic function f(z) = u + iv. Such a problem arises in the mathematical theory of periodic, irrotational waves of finite amplitude in an incompressible fluid of infinite depth in which case delta u = 0 in r < 1 and u subscript n = p(e to the -3v power)sin u on r = 1. Other investigations considered under this contract are also discussed. TAB

N68-11314# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPUTATIONAL ASPECTS OF THE PROBLEM OF OPTIMAL FLIGHT AS A BOUNDARY PROBLEM

V. K. Isayev and V. V. Sonin 31 Mar. 1967 18 p Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 5, no. 2, 1965 p 252–261

(Contract AF 33(657)-14782)

(FTD-HT-67-447; TT-67-63211; AD-660345)

A modification of the Newton method for solving boundary problems for ordinary differential equations is applied to the problem of optimal motion of a point of variable mass M(t) in a central gravitational field with a limited expenditure of power. TAB

N68-11320# Wisconsin Univ., Madison. Mathematics Research Center.

A COMPOSITION METHOD FOR LARGE STRUCTURED NON-LINEAR PROGRAMS

K. Ritter and M. D. Grigoriadis Aug. 1967 25 p refs

(Contract DA-31-124-ARO(D)-462; Grant NSF GP-6070)

(MRC-TSR-786;;AD-660500)

A decomposition method for large non-linear programming problems with structural linear constraints is described. The method can be applied to problems with a block diagonal structure and both coupling constraints and coupling variables. Author (TAB)

N68-11349# Wisconsin Univ., Madison. Mathematics Research Center.

COMPOSITION LIMIT THEOREMS FOR PROBABILITY GENERATING FUNCTIONS

J. D. Church Mar. 1967 41 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-732; AD-660508)

Let (f sub k), k = 1 to k = infinity be any sequence of probability generating functions. It is established that sequential composition in the order f sub 1 (f sub 2(...(f sub k)...)) generates a convergent sequence of functions, and that composition in the order f sub k (f sub (k-1)(...(f sub 1)...)) generates a sequence of functions which converges when the values at zero converge. Properties of the limit functions are related to properties of (f sub k), k = 1 to k = infinity. Author (TAB)

N68-11354# California Univ., Berkeley. Dept. of Mathematics.

NEW RESULTS ON PERIODIC SURFACES AND THE AVERAGING PRINCIPLE

Stephen P. Diliberto Aug. 1967 45 p refs

(Contract Nonr-222(88))

(AD-660052)

In his recent work on periodic surfaces Sacker established the existence of an epsilon-family y = S(theta, epsilon) defined for an open interval of the perturbation parameter epsilon not including zero, i.e. for suitable epsilon superscript 0, S is defined for 0 < epsilon < t superscript 0. One result of this paper is to show lim as epsilon approaches 0 of S(theta, epsilon) exists and to calculate it. The tools developed for doing this also allow one to give a complete version of the averaging principle as a device for finding expansions for solutions--provided one uses the authors generalization of the K-B averaging technique. Author (TAB)

N68-11361# Stanford Univ., Calif. Dept. of Statistics.

BAYESIAN DESIGN OF SINGLE, DOUBLE, AND SEQUENTIAL STRATIFIED SAMPLING FOR ESTIMATING PROPORTION IN FINITE POPULATIONS

S. Zacks 22 Sep. 1967 39 p refs

(Contract Nonr-225(52))

(TR-127; AD-660045)

The problem of optimal allocation in stratified sampling to estimate a vector of proportions is studied from the Bayesian point of view. A linear function of the proportions is analyzed to

make the problem more manageable. In particular, an investigation of double and sequential Bayes stratified sampling is performed. The methodology is outlined and two special cases are worked out: the cases of binomial and of uniform prior distributions of the number of elements in the strata having a certain attribute. The Bayesian efficiency of inverse sequential stratified sampling is studied in relation to the Bayesian stratified simple random sampling. Author (TAB)

N68-11494*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRODUCTS OF SOME GENERALIZED FUNCTIONS

Robert C. Costen Washington Nov. 1967 36 p refs

(NASA-TN-D-4244) CFSTI: HC$3.00/MF$0.65 CSCL 12A

The purpose of this report is to define a new class of generalized functions which includes products of all members of the class. Application is made to the families of generalized functions derived from tanh nx (hyperbolic tangent family) and from $ne^{-n^2x^2}$ (Gaussian family), where n is a sequence index and x the independent variable. Elementary uses of the product analysis in physics are also presented. The hyperbolic tangent family of generalized functions has the following features: The Dirac delta functions $\delta_n(x)$ and its derivatives are polynomials in the Heaviside unit step function $H_n(x)$ multiplied by powers of the sequence index n. Conversely, powers of $H_n(x)$ may be expressed as linear sums of $H_n(x)$, $\delta_n(x)$, $\delta'_n(x)$, . . . with coefficients containing powers of n. Products of these generalized functions are similarly expressed either as polynomials in $H_n(x)$ or as linear sums of $H_n(x)$, $\delta_n(x)$, $\delta'_n(x)$, ... The Gaussian family of generalized functions has analogous features, but products are not the same in the two families. Author

N68-11495# Wisconsin Univ., Madison. Mathematics Research Center.

SOME BAYESIAN STRATIFIED TWO-PHASE SAMPLING RESULTS

Norman R. Draper and Irwin Guttman May 1967 25 p refs

(Contracts DA-31-124-ARO(D)-462; Nonr-1202(17))

(MRC-TSR-747; AD-660510)

In this paper we obtain some results concerning the optimum allocation of sampling effort among k strata at the second phase of a two phase sampling procedure, using information obtained from the first phase. Two different approaches are employed; a Bayesian posterior analysis and a Bayesian preposterior analysis. Two different allocation methods are derived and illustrated with some numerical examples, for cases where some or all of the nuisance parameters are unknown. The problem when all nuisance parameters are known has been discussed by Ericson (1965). Author (TAB)

N68-11502# Wisconsin Univ., Madison. Mathematics Research Center.

ITERATED DEFERRED CORRECTIONS FOR NONLINEAR OPERATOR EQUATIONS

Victor Pereyra Jul. 1967 21 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-763; AD-660509)

It is shown that a Theorem by Stetter on asymptotic expansions can be obtained with fewer hypotheses, and that correction operators for improving the order of convergence of discretization algorithms can be constructed under fairly weak assumptions. Author (TAB)

N68-11505# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

VARIANCE OF AN INCREASINGLY SMOOTHED RANDOM VARIABLE

W. T. Hinds 5 Sep. 1967 14 p refs Presented at USAEC Meteorol. Inform. Meeting, Chalk River, Ontario, Can.

(Contract AT(45-1)-1830)

(BNWL-SA-1406; CONF-670931-9) CFSTI: HC$3.00/MF$0.65

The rate of decrease of the variance of a stationary random function with increasing smoothing is examined from the view-point of the definition of variance. Assuming the smoothing interval, t, to be small with respect to the length of record, and the variance to be calculated from overlapping running means, it is shown that the variance, σ^2, is related to smoothing interval by $d\sigma^2/\sigma^2{}_0 = 2[(P(t/2)/\sigma^2) - 1]dt/t$ where $P(t/2)$ is the autocovariance at lag $t/2$. Semi-empirical forms for $P(t/2)$ are shown to provide a good fit for results from time series of both Gaussian and non-Gaussian distributions, and to yield fair estimates of the autocovariance as a function of lag time. Author (NSA)

N68-11517# Wisconsin Univ., Madison. Mathematics Research Center.

COLLECTIVELY COMPACT AND TOTALLY BOUNDED SETS OF LINEAR OPERATORS

P. M. Anselone Jul. 1967 21 p refs

(Contract DA-31-124-ARO(D)-462)

(MRC-TSR-766; AD-660502)

A set Kappa of linear operators on a normed linear space X into a normed linear space Y is collectively compact if the set (Kx : K epsilon Kappa, Norm x = or < 1) has compact closure. It is proved that if Kappa and Kappa star = (K star : K epsilon Kappa) are collectively compact and dim KX = or < n for all K epsilon Kappa (n = 1, 2, ...), then Kappa is totally bounded. Author (TAB)

N68-11619*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ORDER OF LEVELS OF SYMMETRIC HAMILTONIANS, PART 1

M. M. Saffren 1 Nov. 1967 29 p refs

(Contract NAS7-100)

(NASA-CR-90411; JPL-TR-32-414, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The bound levels of a particle in a symmetric potential are shown to be ordered according to symmetry type. The odering depends solely on the symmetry of the potential and not on its particular form. As examples, the order of levels of a particle in both a cubically symmetric and a tetrahedrally symmetric potential is given and discussed. Author

N68-11639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MULTIPLE DECISION PROCEDURES FOR ANOVA OF TWO-LEVEL FACTORIAL FIXED-EFFECTS REPLICATION-FREE EXPERIMENTS

Arthur G. Holms and J. N. Berrettoni (Ph.D. Thesis—Western Reserve Univ.) Washington Dec. 1967 46 p refs

(NASA-TN-D-4272) CFSTI: HC$3.00/MF$0.65 CSCL 12A

For expensive areas of experimentation, such as alloy development, pressure vessel burst testing, and high-temperature protective coatings, the appropriate experiments consist of two-level fixed-effects factorial designs without replication. No adequate procedures have been available for the statistical analysis of such experiments. A procedure called "chain pooling" is introduced for testing the significance of terms of a model equation as fitted to the observations from a fractional factorial experiment. The procedure starts with a small group containing only the smallest of the ordered squared coefficients of the model equation in the denominator of a test statistic. Stepwise testing, in the increasing order of succeeding squared coefficients, pools insignificant squares into the denominator of the statistic, which is used for continued testing. Monte Carlo computations were performed to determine the decision

error probabilities for many different variations of chain pooling and to compare the relative advantages of the variations for fractional factorial experiments with 2^4, 2^5, and 2^6 treatment combinations. These computations were performed with values of the significant coefficients distributed in such a manner as to contribute to high probabilities of decision errors, so that the recommended procedures are good against the worst possible conditions. Author

N68-11654# RAND Corp., Santa Monica, Calif.
AN INTEGRAL EQUATION AND A REPRESENTATION FOR GREEN'S FUNCTION
H. H. Kagiwada, R. E. Kalaba, A Schumitzky, and R. Sridhar Oct. 1967 9 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5476-PR; AD-660097)

The report discusses a method for representing a Greens function using a Fredholm integral equation for which effective solution methods are known. The final step in the mathematical solution of many problems in mathematical physics and engineering is the solution of a linear two-point boundary differential equation, of which the Greens function provides the solution of interest. Greens functions have been regarded as only of theoretical interest because of the difficulty of computing them. An initial-value method using Hadamards variational formula was presented in AD-648 654; the present study gives an alternative method in which the differential equations and auxiliary conditions are transformed into integral equations. TAB

N68-11655# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A NUMERICAL INTEGRATION SCHEME BASED UPON AN EXPANSION ABOUT THE DEPENDENT VARIABLE
V. L. Kirk Nov. 1967 20 p refs
(R67SD52) CFSTI: HC $3.00/MF $0.65

There are systems of ordinary differential equations which somewhere require such small step sizes that these systems are regarded as virtually unsolvable by ordinary numerical means. When such a system is in autonomous form, a first order method of solution exists which may permit much larger step sizes. However, the method requires an extensive analysis of each problem and the general use of complex arithmetic. In this paper the method is altered to eliminate any analysis and, as an aside, an estimate of the truncation error is given for a special case. This new method is shown to converge and the need for complex arithmetic is altogether eliminated. The overall effect is that the new method can be used with the same ease as the more popular methods. Although the latter methods use less storage space and require less running time per step, the potentially vast increase in step size has the ultimate effect of creating economical problems. For purposes of comparison, the Runge–Kutta 4th order method will be used. Author

N68-11720# Stanford Research Inst., Menlo Park, Calif. Mathematical Sciences Dept.
SENSITIVITY TESTING
George W. Evans, Robert C. McCarty, and J. Bryce Tysver Oct. 1967 41 p

Three methods for designing and analyzing a sensitivity test (binomial experiment), a selection rule for choosing the runs in the experiment, and a possible classification of physical problems that lend themselves to sensitivity testing are described. The statistical considerations involved in sensitivity tests are emphasized. Author

N68-11771# RAND Corp., Santa Monica, Calif.
SEPARABLE MARKOVIAN DECISION PROBLEMS
Eric V. Denardo Oct. 1967 28 p refs Submitted for publication
(P-3448-2; AD-659726)

The special structure of a class of Markovian decision problems is exploited to simplify the determination of optimum policies. For certain pairs consisting of a state i and decision k, the cost c subscript i superscript k separates (c subscript i superscript k = a sub i + b sub k), while the transition probabilities p subscript ij superscript k and transition time distributions F subscript ij superscript k are independent of i. Equivalence of a second Markovian decision problem which exploits this structure is demonstrated for the discounted and averaging cases. In addition, streamlined approaches are presented for dealing directly with the original problem and a particular inventory model is further simplified. Author (TAB)

N68-11800# Washington Univ., Seattle. Statistical Research Lab.
ON THE DISTRIBUTION OF PRODUCTS OF INDEPENDENT BETA VARIABLES
Z. A. Lomnicki 15 Sep. 1967 37 p refs
(Contract Nonr-477(38))
(TR-50; AD-660189)

The problem of finding the probability distribution of a product of a number of identically distributed, independent random variables had been solved by an application of the Mellin transform for normal and Cauchy distributions (Springer and Thompson) and for exponential, Gamma and Weibull distributions (Lomnicki). The present paper shows that it can be solved by similar methods for Beta distributions. This is of practical importance, since most physical quantities with which an engineer is dealing have finite ranges, while all the distributions previously studied had infinite ranges. Author (TAB)

N68-11838# Technische Hogeschool, Eindhoven (Netherlands).
POINT-FREE CARRIER SPACE TOPOLOGY FOR COMMUTATIVE BANACH ALGEBRAS
Willem Van der Meiden [1967] 85 p refs
CFSTI: HC $3.00/MF $0.65

Consideration is given to the problem of constructing a lattice of sets of ideals of the Banach algebra, featuring the main properties of the lattice of all closed sets in a topological space. The axiom of choice is not used in formulating the general properties of commutative Banach algebras with identity element, the properties of spectra, the *-operation and the lattice of *-invariant sets of closed ideals, and the lattice of clusters. The restricted axiom of choice is used to obtain certain compactness properties. Connections with the space of maximal ideals are given, along with several conclusions which depend on the unrestricted axiom. M.G.J.

N68-11861* State Univ. of New York, Stony Brook.
PRODUCT FORM OF INVERSES OF SPARSE MATRICES AND RELATED TOPICS Progress Report, 1 Jun. 1965–30 Nov. 1967
R. P. Tewarson Dec. 1967 7 p refs
(Grant NGR-33-015-013)
(NASA-CR-90534) CFSTI: $3.00 CSCL 12A

Concise summaries are presented of publications and reports that were generated in connection with studies on sparse matrix inverse product forms and related topics. In view of these summaries it is shown that in inverting sparse matrices (both singular and nonsingular), significant savings in time and storage can be made by the proper choice of pivots. The efficiency of a particular method depends on the structure of the matrix being inverted, especially if the nonzero elements of the given matrix are not randomly distributed. The choice of a particular method should be made on the basis of the type of matrices one is most likely to

have for inversion. However, if it is not possible to determine the structure of the matrices in advance, then the assumption that its nonzero elements are randomly distributed works well. It is pointed out that computing the product form of the inverse is equivalent to the Gauss–Jordan elimination method for the solution of simultaneous linear equations. C.T.C.

N68-11868*# Georgia Univ., Athens. Dept. of Statistics.
ON THE DISTRIBUTION OF THE SUM OF INDEPENDENT DOUBLY TRUNCATED GAMMA VARIABLES
D. Earl Lavender (Ph.D. Thesis, Aug. 1966) Nov. 1967 57 p refs
(Contract NAS8-11175)
(NASA-CR-61184) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The density and distribution functions of the sum of N independent doubly truncated Gamma variables is derived for the case where the parameter α is one and N is any positive integer and for the cases where N=2 or N=3 and α is any positive integer. Tables of critical values for these distributions are given as functions of the truncation points, and a comparison is made between these critical values and the estimated critical values given by Pearson's β_1 and β_2 tables. Author

N68-11905*# Houston Univ., Tex.
[ESTIMATION OF TRANSITION MATRICES, ABELIAN GROUPS, STRUCTURE OF NEAR-RINGS, AND METRIZATION OF TOPOLOGICAL SPACES] Semiannual Status Report, Jun. 1–Nov. 30, 1967
30 Nov. 1967 10 p
(Grant NGR-44-005-037)
(NASA-CR-90753) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Continuing research activities in the field of mathematics are briefly reported. Problems involving nonnegative matrices, in conjunction with monotone homogeneous operators, are described. Initial work on a theorem concerning a particular lattice ordered group is mentioned. Completed and partial results on the relationship between the existence of various real-valued functions on a topological space and various topological properties of the space are outlined. Investigations in the development of homological ideas in algebraic theory of semigroups and the theory of topological groups include tensor and torsion products of commutative semigroups. N.E.N.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-11022# France. Direction de la Meteorologie Nationale, Paris.
EVALUATION METHOD OF HYDROLOGIC DISTRIBUTION. APPLICATION TO THE CEZE BASIN [METHODE D'EVALUATION D'UN BILAN HYDROLOGIQUE. APPLICATION AU BASSIN DE LA CEZE]
A. Orieux, E. Pouget, A. Barbia, and H. Sabadel Aug. 1967 35 p refs In FRENCH *Its* Monograph. No. 60
CFSTI: HC $3.00/MF $0.65

Methods of determining soil humidity and underground hydrological reserves are described. These include measurements of the potential daily evaporation–transpiration rate, the daily precipitation less the amount lost by evaporation–transpiration, the theoretical flow, the depletion of the underground water table, and correlated data on the effects of the rainy season and soil replenishment. The data are graphically depicted. Transl. by M.G.J.

N68-11319# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF SYNOPTIC FRONTS ON THE QUALITY OF IMAGES
N. I. Kucherov 20 Apr. 1967 18 p refs Transl. into ENGLISH from the book "Vliyanike Sinopticheskikh Frontov Na Kacheetvo Izobrazheniy" Moscow, Izd-Vo Nauka, 1965 p 49–59
(FTD-HT-66-604; TT-67-63134; AD-659907)

A comparison of optical instability of the atmosphere (by means of the turbulence angle) and the mean square amplitude of light tremor of a star shows a considerable difference for different observatories. It is suggested that the variation is due to weather fronts. Observations show that the image is good (i.e., the angle of turbulence is small and stable) when frontal activity is absent; the image worsens when a frontal zone approaches; and the image improves as the frontal zone recedes. Observations were made at Chapal, Krasnyye Gory, and Privetnoye during 1961-62, and 75% of the observations attest to the above-stated relationship. Of the remaining 25%, 15% show a good image despite the presence of a front or a poor image though no front appeared to be present; 10% were doubtful examples because of uncertain synoptic analysis. It is pointed out that the synoptic fronts were chiefly cold fronts. Turbulent movements near the surface of a warm front are less well defined than in the zone of a cold front because of the very small slope of warm fronts and of smaller horizontal temperature gradients. The author believes that the statistically demonstrated relationship sheds light on many properties of astroclimate, and he suggests that it offers some promise for locating future astronomical observatories. Author (TAB)

N68-11340# Air Weather Service, Scott AFB, Ill.
NOTES ON ANALYSIS AND SEVERE-STORM FORECASTING PROCEDURES OF THE MILITARY WEATHER WARNING CENTER
Robert C. Miller Jul. 1967 151 p refs
(TR-200; AD-660092)

The collection of notes discusses the various types of severe-weather air masses, how severe weather systems form, which parameters best define the existence and intensity of severe weather, and how to use local information to better forecast the occurrence of phenomena at individual stations. Specifically, wind gust and hail-size forecasting techniques and the usefulness of various stability indexes are presented. Also, a chapter on severe weather in tropical air masses is included. Finally, a number of detailed case studies are in the report to help the reader visualize how forecasting concepts are applied, and to emphasize the importance of forecasting experience. Author (TAB)

N68-11343# Mitre Corp., Bedford, Mass.
COLD LAKE RADIO PROPAGATION AND METEOROLOGICAL EXPERIMENT. VOLUME 2: DETERMINATION OF RADIO PROPAGATION CONDITIONS FROM INTERFEROMETER AND LAKE SURFACE MEASUREMENTS
Lyall G. Rowlandson Aug. 1967 64 p refs
(Contract AF 19(628)-5165)
(MRT-118, V. 2; ESD-TR-67-357, V. 2; AD-659747)

Reflection interferometer measurements can be used to describe the propagation condition affecting the degree of ray-path bending. In combination with these measurements relatively simple meteorological measurements at the lake surface can indicate the magnitude of the refractivity gradient and its vertical extent. In combination, the two methods appear to provide a technique to determine the effective propagation conditions by direct radio signal diagnosis and with a minimum degree of meteorological support. Author (TAB)

N68-11364 National Environmental Satellite Center, Washington, D. C.
THE SINAP PROBLEM: PRESENT STATUS AND FUTURE PROSPECTS
E. Paul McClain Oct. 1967 29 p refs Proc. of the Conf. held in Suitland, Md., 18–20 Jan. 1967
(NESC-41)

The present status and future prospects of the problem of incorporating largely qualitative, meteorological satellite data into numerical weather analysis and forecast models were examined. Three main aspects of the task were discussed: relating satellite information to atmospheric structure, incorporating the information into operational analyses, and assessing the results. Included in the proceedings are a comprehensive review and a bibliography of research in this area. Special problem areas and some prospects for the future were also discussed. Author

N68-11384# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPARING ELSASSER AND GOODY MODELS OF SPECTRAL ABSORPTION BAND OF INFRARED RADIATION BY WATER VAPORS
N. I. Kozhevnikov 1 May 1967 12 p refs Transl. into ENGLISH from Izd-Vo Mosk. Univ. (USSR), no. 131, 1964 p 3–9
(FTD-HT-66-617; TT-67-63245; AD-660434)

A comparison was made of the Elsasser and the Goody models with respect to proper representation of experimental data on the absorption of infrared solar radiation by water vapor. TAB

N68-11401# Air Weather Service, Washington, D. C.
RADIOSONDE DEW-POINT ACCURACIES 40°C TO −40°C
Lloyd V. Mitchell Aug. 1967 27 p refs
(TR-198; AD-659760)

In most of the literature, accuracies for radiosonde-measured atmospheric moisture are expressed in terms of relative humidity, i.e., the percent of saturation. The report presents the radiosonde-measured atmospheric moisture accuracies in terms of dew point, i.e., saturation temperature. The dew-point root-mean-square (RMS) errors are presented in tables which resulted from the computations and in nomograms for ready use. A table and a nomogram are included for temperatures between 0C and 40C, and another of each for temperatures between -40C and 0C. Dew-point accuracies are least for high temperatures and low dew points and greatest for low temperatures and high dew points in each temperature group, viz., 0C to 40C and -40C to 0C. Author (TAB)

N68-11435# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE MOUNTAIN IRON DIFFUSION PROGRAM
W. T. Hinds 5 Sep. 1967 30 p refs Presented at the USAEC Meteorol. Inform. Meeting, Chalk River, Ontario
(Contract AT(45-1)-1830)
(BNWL-SA-1401; CONF-670931-8) CFSTI: HC $3.00/MF $0.65

From November, 1965 through July, 1966, a large-scale program designed to illuminate the diffusion characteristics of marine air over coastal range mountains was carried out in Southern California, at Vandenberg Air Force Base. The experimental design for this program is outlined, and salient features of diffusion analysis are presented. The technique developed for predicting plume width, based on the Hay–Pasquill running average method, indicated that $\beta = 200/\sigma_\phi$ much larger than heretofore reported for unstable conditions. The prediction of centerline exposures over mountainous terrain was shown to be dependent upon temperature stratification in a different manner than observed level terrain, and that exposures were generally lower and less dependent upon both season and time of day over mountainous country. Author (NSA)

N68-11436# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
COMPARISON OF TURBULENCE SPECTRA FROM HANFORD, WASHINGTON AND LIBERAL, KANSAS
C. E. Elderkin 5 Sep. 1967 13 p refs Presented at the USAEC Meteorol. Inform. Meeting, Chalk River, Ontario
(Contract AT(45-1)-1830)
(BNWL-SA-1403; CONF-670931-5) CFSTI: HC $3.00/MF $0.65

Turbulence measurements were made both at Hanford, Washington, on the Atomic Energy Reservation, and at Liberal, Kansas, site of the Air Force Cambridge Research Laboratory micrometeorological field studies. The same instrument was used for measuring the three components of the wind at both sites and the same analog computer equipment and techniques were used for analysis of the data, assuring an optimum basis for comparison of turbulence spectra from the two regions which differ considerably in terrain features and vegetation cover. In spite of the differences in physical characteristics of the two sites, the normalized spectral distributions for each of three components have similar shapes at the two sites, demonstrating occurrence of peaks and approaches to the inertial subrange in comparable ranges of normalized wave number, nz/U. Author (NSA)

N68-11437# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PRECIPITATION SCAVENGING OF SUBMICRON PARTICLES. PART A: THEORY
W. G. N. Slinn 5 Sep. 1967 14 p refs Presented at the USAEC Meteorol. Inform. Meeting, Chalk River, Ontario
(Contract AT(45-1)-1830)
(BNWL-SA-1402; CONF-670931-10) CFSTI: HC $3.00/MF $0.65

For the precipitation scavenging of submicron particles, inertial effects are shown to be negligible by transforming Newton's law to the mass independent Smoluchowski equation. The importance of electrical effects can be displayed theoretically but its evaluation requires more specific information about the charges on raindrops and particles. Heat transfer data are utilized to calculate the washout coefficient and the result is found to be a factor of two to ten below Ziman's. Author (NSA)

N68-11508# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
VARIATION OF CONCENTRATION IN PLUMES AND BUILDING WAKES
W. T. Hinds 5 Sep. 1967 41 p refs Presented at USAEC Meteorol. Inform. Meeting, Chalk River, Ontario, Can.
(Contract AT(45-1)-1830)
(BNWL-SA-1400; CONF-670931-7) CFSTI: HC $3.00/MF $0.65

A short series of experiments to define the effect of wake flow on the variance of concentration is described. The time history of concentration at a point in building wakes from ground level sources was found to differ little from that observed in a plume from a point source. An approximate power law dependence of peak to mean ratios on averaging interval was observed in both wakes and unobstructed plumes, but ground level sources in wake flow yielded peak to mean ratios comparable to those observed from unobstructed elevated sources. Thus, it is surmised that elevated releases into wake flow probably will yield greater peak to mean ratios than unobstructed elevated sources. Author (NSA)

N68-11518# Miami Univ., Fla. Radar Meteorological Lab.
MESOSCALE STUDIES OF INSTABILITY PATTERNS AND WINDS IN THE TROPICS Final Report, 1 Jun. 1965–31 May 1967
Harold P. Gerrish Sep. 1967 82 p refs
(Contract DA-28-043-AMC-00443(E))
(ECOM-00443-F; Rept.-14; AD-659786)

Rainfall rates in easterly wave and air mass showers at the University of Miami are studied using raindrop camera data collected for the Illinois State Water Survey in 1957-58. It is observed that the first minutes of air mass rain are typically heavier than easterly wave rain. Two severe rainstorms in South Florida are discussed and analytical techniques are appraised. A revised climatology of tornadoes and waterspouts in this area is presented and discussed. Review of the pertinent synoptic maps substantiates that the bulk of this type of activity occurs in unsuspicious summer trade-wind or ridge patterns at the surface with the jet stream well removed from the area. Radar signatures are studied and illustrated. Some tornadoes and waterspouts in South Florida are observed to be associated with intersecting fine lines from convection. This is visualized as a new application of the earlier pressure-jump theories. Here the piston mechanism is convection itself and the leading edge of the cold outflow acts like a rapidly moving cold front. Refractive conditions associated with tornadoes, waterspouts and hail are also described, and mean temperature soundings are illustrated for these events. Author (TAB)

N68-11539# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PRECIPITATION SCAVENGING OF SUBMICRON PARTICLES. PART B: COMPARISON OF THEORY WITH FIELD EXPERIMENTS

D. I. Hagen 5 Sep. 1967 12 p refs Presented at USAEC Meteorol. Inform. Meeting, Chalk River, Ontario, Can.
(Contract AT(45-1)-1830)
(BNWL-5A-1405; CONF-670931-6) CFSTI: HC $3.00/MF $0.65

Calculations based on convective and Brownian diffusion are found to predict within experimental error the rain washout coefficients measured in the field for sub-micron silver iodide particles. These particles, similar to those used in cloud seeding work, have a log normal distribution with geometric mean diameter of .012 μ. Author (NSA)

N68-11609# Environmental Science Services Administration, Las Vegas, Nev. Air Resources Field Research Office.

LONG RANGE TRAJECTORIES

P. W. Allen, E. A. Jessup, and R. E. White [1967] 19 p refs Presented at USAEC Meteorol. Inform. Meeting, Chalk River, Ontario, Can.
(CONF-670931-1) CFSTI: HC $3.00/MF $0.65

A series of 444 trajectory forecasts originating in southern Nevada at 10 and 12 thousand feet and prepared routinely by The Air Resources Field Research Office forecasters have been compared with trajectories which were reconstructed from wind data with standard vector differences of approximately half of the trajectory length. Reconstructed trajectories were compared with a smaller number of tetroon trajectories, showing large standard vector deviations. Dispersion of tetroon clusters can account for only 1/5 to 1/6 of the deviation of the reconstructed trajectories. Graphs are illustrated for estimating the standard vector error of trajectory forecasts. Most of the difficulty in trajectory prediction and construction is attributed to the complexity of flow over mountain ridges and the inadequacy of network wind data in the inter-mountain area. Author (NSA)

N68-11859# RAND Corp., Santa Monica, Calif.

THERMAL CONVECTION IN THE ATMOSPHERIC BOUNDARY LAYER

C. B. Leovy Nov. 1967 31 p refs
(Contract NSF C-415)
(RM-5432-NSF)

A formulation is proposed to relate the heat flux across the convective atmospheric boundary layer to friction velocity, temperature drop across the boundary layer, molecular thermal diffusivity, and the buoyancy parameter $g\sqrt{T}$. The basic hypothesis is that the turbulent convective boundary layer joins smoothly to a region of molecular conduction near the surface. The region of molecular conduction is assumed to exist whether momentum transfer corresponds to rough or smooth flow. In addition, the formulation predicts a relation which agrees well with laboratory convection experiments in the limiting case of vanishing friction velocity. Some of the atmospheric data appear to have been obtained under atmospheric conditions approaching the wind-free laboratory convection. The formulation clarifies the transition between convection influenced by wind and wind-free convection. The formulation appears to work in some cases when deviations from the assumed flux-gradient relation should be important. Author

N68-11886# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.

DYNAMICS OF THE ANTARCTIC CIRCUMPOLAR CURRENT (ACC). PART 2

Takashi Ichiye Jun. 1967 32 p refs
(Grant NSF GA-258)
(CU-2-67, Pt. 2; PB-174941) CFSTI: HC $3.00/MF $0.65

Dimensionless forms of the linearized equations of motion are derived about the transports of the A.C.C. which is assumed to be barotropic. The scaling process indicates that the geostrophic equilibrium is predominant and that the zonal wind stress is balanced with the bottom friction and the Coriolis term. The horizontal eddy viscosity terms are less than these terms at least by one order of magnitude. The vorticity relation postulates that the streamlines be parallel to the isolines of f/H, where f is the Coriolis parameter and H is the depth. The magnitude of the quasi-zonal transport depends on the meridional transport as well as the zonal wind stress. The average meridional transport determined from the observed wind stress and zonal transport is northward and about 5×1,000 sq cm/sec, almost equaling the value estimated in the previous report. The rotating model experiments indicate that the effect of cooling along the periphery of the Antarctic continent generates eastward transport, in agreement with the theory. Also, the experiments show that the main features of the A.C.C. are maintained by the wind-driven current. Author (TAB)

N68-11887# Environmental Science Services Administration, Miami, Fla. National Hurricane Research Lab.

ON THE STRUCTURE OF HURRICANE ELLA (1962)

R. C. Sheets Apr. 1967 39 p refs
(IERTM-NHRL-77; PB-174667) CFSTI: HC $3.00/MF $0.65

The U. S. Weather Bureau research aircraft investigated this storm during 4 days of a 5-day period. The investigation included 2 days of data obtained before the storm had reached hurricane intensity and 2 days of data obtained after the storm had attained hurricane strength. Therefore, the data presented here depicts the storm during its developing and mature stages. The structure of the storm is presented in the form profiles and horizontal cross sections of the various parameters, including winds, temperature, pressure, and precipitation fields in the form of radar presentations. An unusual flow pattern observed on October 17 is investigated in some detail and the divergence field is presented for one level on this day. Also, the changing thermal structure is discussed in some detail. Author (TAB)

N68-11894# Environmental Science Services Administration, Miami, Fla. National Hurricane Research Lab.

ON THE STRUCTURE OF HURRICANE JANICE

R. C. Sheets Apr. 1967 44 p refs
(IERTM-NHRL-76; PB-174666) CFSTI: HC $3.00/MF $0.65

Hurricane Janice first appeared as a disturbed area south of Cuba. The first of seven missions flown into the storm occurred on October 5, before it had attained hurricane intensity, the last on

October 9, just before the storm experienced a rapid acceleration and intensification. The structure of hurricane Janice during the developing and mature stages is described in this report. Profiles, horizontal cross sections, and radar photograph composites are presented. Particular attention has been given to the radar structure because of the somewhat three-dimensional nature of the data. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-11084* Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
GIMBALLESS INERTIAL NAVIGATION SYSTEMS Final Report, Nov. 1, 1966–Apr. 30, 1967
Kenneth A. Fegley Jun. 1967 47 p refs
(Grant NGR-39-010-029)
(NASA-CR-90222; Rept.-67-29) CSCL 17G

Three orthogonalization techniques of correcting computer errors and computational scheme errors in the direction cosine matrix are described. These methods use the orthogonality property of the correct matrix and they include a vectorial orthogonalization technique, an inversion transposition and averaging technique, and an improved inversion transposition and averaging technique. Their effectiveness is shown in the case where only the first order term of the Taylor series is used to compute the direction cosine matrix. The performances of these three techniques are compared with a series orthogonalization technique. A method of deriving angular acceleration is outlined. Analytical expressions are derived for the instantaneous errors in the angular velocity and linear acceleration of the center of gravity of a vehicle where the source of these errors is the parallel displacement of any of the six accelerometers from their nominal location. The results directly give the location and orientation of the center of mass of the vehicle for the case where the accelerometers are not grouped about the center of mass. R.N.A.

N68-11110*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOCAL ERROR CONTROL AND ITS EFFECTS ON THE OPTIMIZATION OF ORBITAL INTEGRATION
C. E. Velez Aug. 1967 32 p refs
(NASA-TM-X-63027; X-553-67-366) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The problem of effecting an efficient and accurate orbital integration by a multistep process using the concept of controlling the local error during the integration was studied. It was shown that the parameters p and h can be used to control the local error during the integration in such a way that the efficiency of the process is improved with no effective sacrifice in accuracy. In particular it was shown that if a sufficiently large range in the local error is allowed, and an order p is given, a variable step control can automatically yield a good approximation of the optimal initial stepsize with respect to the given order and can specifically improve the efficiency of the process by varying this step during the integration. A derivation of the summed form of integration formulas used, and the equations of motion used to obtain the numerical results are given. L.S.

N68-11126# Naval Research Lab., Washington, D. C.
LANE IDENTIFICATION IN THE OMEGA SYSTEM Interim Report
J. W. Brogden and K. O. L. Luken 28 Jul. 1967 47 p ref
(NRL-Memo-1803; AD-659959)

The first step of removing the position ambiguity in the Omega system is to identify the correct 10.2 kiloHertz (kHz) lane. This is accomplished by means of the 13.6 kHz transmissions which result in a difference frequency of 3.4 kHz and increase the width of the ambiguous zone by a factor of three to 24 miles. This is the most critical step in the ambiguity resolution procedure. Omega monitors were operated in Washington, D. C., and Orlando, Florida, to obtain information on the repeatability and reliability of the 3.4 kHz phase difference. The absolute position accuracy is not considered in this report. The data show that on the basis of repeatability lane identification is possible at least 95% of the time except on occasions during transition periods, light-to-dark or vice versa. Diurnal variations and fixed errors can be removed with available sky-wave correction tables. TAB

N68-11146* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
NUMERICAL STUDIES OF TRANSITIONS BETWEEN THE RESTRICTED PROBLEM OF THREE BODIES AND THE PROBLEM OF TWO FIXED CENTERS AND THE KEPLER PROBLEM
R. F. Hoelker Washington NASA Nov. 1967 33 p refs
(NASA-TM-X-1465) CFSTI: $3.00 CSCL 22C

For the comparison of the trajectories of the two fixed-center problem with those of the restricted problem of three bodies, fields of trajectories are numerically computed for six initial position conditions, all starting on the line of masses and perpendicularly to this line. The transition is studied by varying stepwise, for these fields, the rate of revolution of the primaries from zero to the equilibrium rate of circular motion. For the investigation of the behavior of trajectories in the transition from the Kepler problem to the restricted problem, the Kepler orbits are considered in a coordinate system rotating at the rate determined by the continuation of this system into that of the restricted problem. Transition characteristics are shown on samples of periodic orbits and of trajectory fields. In particular, the continuous transition of a family of Kepler orbits into periodic orbits about the smaller primary as well as about the L_3-libration point is demonstrated. Author

N68-11179*# TRW Systems Group, Redondo Beach, Calif.
APPROACH GUIDANCE SYSTEM: PROTOTYPE COMPUTER PROGRAM DEFINITION
D. D. Bennett and J. J. Goldman 22 Sep. 1967 59 p refs
Prepared for JPL
(Contracts NAS7-100; JPL-951936)
(NASA-CR-90331; TRW-09059-6002-R000) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Input/out description, program control input data, and the various subroutines are presented for the prototype computer program definition for the mathematical model of the Approach Guidance System (AGS). The presented definition will simulate observations for the AGS, and the resultant measurements will be used to estimate spacecraft orbit. A description of the overall program layout and of each of the 10 subroutines is included along with the necessary flow diagrams. M.W.R.

N68-11330# Navy Electronics Lab., San Diego, Calif.
THE OMEGA DIGITAL PHASE SHIFTER Research and Development Report, Nov. 1964–Dec. 1966
John J. Wilson 2 Aug. 1967 61 p ref
(NELC-1503; AD-659985)

A Digital Phase Shifter was developed for use with the Omega long-range navigation system. When used in conjunction with an error signal A/D Converter, it maintains Omega carrier frequency phase to within 0.225 of a centicycle. Further development using integrated logic circuits is recommended. Author (TAB)

N68-11341# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
NOTES ON CIVIL NAVIGATION AND TRAFFIC CONTROL TECHNOLOGY
Pierre A. Portmann Oct. 1967 74 p refs
(Contract DAHC15-C-67-0011)
(P-323; AD-659999)

Current navigation and communication systems in civilian activities satisfy a large number of users both for ship and aircraft activities. A trend toward closer traffic control of both ships and aircraft makes it necessary to consider ways of improving both of these capabilities for future air and sea vehicles. An examination of new system design concepts shows little likelihood of user acceptance from economic or technical considerations. There is a need to develop a system concept which will provide graduated system performance (in accuracy and rate of updating fixes) with a corresponding graduated economic burden. A satellite system is suggested as a means of developing such a capability and some preliminary estimates are made of the technical characteristics required to provide such a system capability. Author (TAB)

N68-11346# Naval Research Lab., Washington, D. C.
OPTICAL GUIDANCE SYSTEMS: ANALYSIS, DESIGN, AND DEVELOPMENT Final Report
Barbour Lee Perry 20 Jul. 1967 78 p refs
(NRL-6581; AD-660172)

Increased safety and reduction of the accident rate in carrier landing are of prime importance to the Navy. Believing that these objectives could be achieved only by a general increase in total system precision, NRL analyzed the landing configuration to locate the sources of present system inaccuracy. Insufficient display gain (sensitivity) and the accompanying lack of necessary derivative signals were found to be primary causes of system imprecision. To alleviate such problems, many new display schemes were accordingly conceived, developed, and experimentally tested. These include the Rainbow Optical Landing System and the Altitude Rate Command (ARC) System, which are high-gain direct displays of rate error information; and the Depth of Flash Optical Landing System, a highly sensitive display of error information presented so that the pilot can accurately extract rate or predictive information. Additional displays covered are the Laterally Compounded Fresnel Lens Optical Landing System, the Ten-fold Fresnel Lens Optical Landing System, the Shadow Box Optical Landing System, the Integrated Fresnel Rainbow Optical Landing System, the Audio system, the Phi Flash system, and several variations of a Depth of Flash system. Author (TAB)

N68-11521*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MIDCOURSE-GUIDANCE PROCEDURE WITH SINGLE POSITION FIX OBTAINED FROM ONBOARD OPTICAL MEASUREMENTS
Harold A. Hamer, Katherine G. Johnson, and W. Thomas Blackshear Washington NASA Dec. 1967 83 p refs
(NASA-TN-D-4248) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A manual procedure is developed for midcourse-guidance application. The procedure required only limited onboard calculations and leads to guidance predictions sufficiently accurate for emergency or backup operations. Although high accuracy cannot be obtained by manual methods as compared with automatic methods, the accuracy of the present method is shown to be adequate to the point where a terminal guidance system could take over with relatively simple equipment. The method is applied to Earth–Moon trajectories and is studied in detail for an example lunar mission. Basically, the determination of only one position fix is required rather than the determination of a large number of position fixes as is usually required in any manual or automatic procedure. This condition is made possible by use of precalculated data which linearly relate deviations from the nominal trajectory at the time of the position fix to those farther along the trajectory. This procedure is especially important for lunar missions where time is limited for making measurements and calculations prior to the first midcourse maneuver. The effects on aim-point accuracy of measurement errors, maneuver errors, star selection, and linear approximation are discussed. Author

N68-11773# Naval Research Lab., Washington, D. C.
PRECIPITATION EFFECTS ON OMEGA AIRCRAFT RECEIVERS Interim Report
R. L. Eisenberg and M. F. Williams 10 Aug. 1967 50 p refs
(NRL-MEMO-1810; AD-660377)

Omega is a very-low-frequency (VLF) radio navigation system which is characterized by very-long-range capability and relatively high accuracy. Fixes with an accuracy of one to two miles can be obtained by ships, aircraft and submerged submarines within a range of more than 5000 nautical miles. Propagation studies have shown that eight stations will provide radio navigation information over the entire earth. The performance studies of the Naval Research Laboratorys Omega aircraft receivers indicate that the use of the Omega navigation system for aircraft is entirely practical. Evaluation flights demonstrate that in good weather and in areas of reasonable signal strength Omega provides excellent navigation for aircraft. In flight the aircraft position is continuously and readily available from counters on the front panel. However, precipitation static effects have had a detrimental effect on receiver operation. Experiments were conducted to determine the effect of precipitation on the reception of VLF in aircraft. On the majority of the NRL flights a two-foot vertical blade antenna has been used (the AN/104AX). This antenna, because of its high base-to-ground impedance, is susceptible to signal output reduction when the base insulator is wetted. A two-foot polyethylene insulated rod antenna has improved characteristics under wetting conditions, but both the blade and the insulated rod are still susceptible to static pickup. A loop antenna appears to have improved characteristics with respect to both wetting and static pickup. The blade and the loop antennas were evaluated in the laboratory and in flight. Oscilloscope pictures demonstrate the results discussed. Author (TAB)

N68-11842*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 2: PERFORMANCE ASSESSMENT OF MIDCOURSE GUIDANCE SYSTEMS
15 Sep. 1966 349 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This document describes the digital computer program that has been developed to study the guidance and navigation requirements for interplanetary missions. The presentation contains the structure of the mathematical model, a computer program description, and a user's guide. The program description is composed primarily of a hierarchical structure of flow charts with concomitant explanatory remarks. The mathematical model equations which are programmed into the computer are stated within the lowest-level flow charts. The flow charts are designed to provide insight into the program operations at several levels of logical and computational complexity. The program is coded in Fortran IV and a listing of the program is given in the Appendix. Author

N68-11844*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTION. PART 4: PERFORMANCE ASSESSMENT FOR ALL INERTIAL GUIDANCE SYSTEMS

[1967] 139 p ref
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 4) CFSTI: HC $3.00/MF $0.65 CSCL 17G

AC Electronics has defined and programmed a digital computer program, (Program 117.1), which evaluates the performance of an inertial guidance system. The computer program provides the capability of conducting a performance analysis of an all-inertial guidance system along the reference trajectory. The basic output of the program consists of the covariance matrix of the velocity and position errors due to independent error sources of the inertial guidance system. The reference trajectory and the state transition matrix are recorded on magnatic tape for use in repetitive runs of Block III for trade-off studies of inertial guidance systems. The program is designed to interface with free-flight programs for interplanetary guidance and navigation. The covariance matrix of velocity and position errors at the beginning of a boost trajectory is combined with the covariance matrix of position and velocity errors due to the inertial guidance system to furnish as output the total covariance of position and velocity errors at the end of the boost trajectory. Hence, a complete study capability is provided for trajectories composed of both boost and free-flight phases
Author

N68-11847*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 7: PERFORMANCE ASSESSMENT OF ATMOSPHERIC ENTRY GUIDANCE SYSTEMS
31 Aug. 1966 382 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 7) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This document describes a digital computer program developed to simulate the performance assessment of atmospheric entry aided-inertial guidance systems. The description contains a mathematical model, a computer program description, a user's guide, an operator's and programmer's guide, and a program listing. The program is written in FORTRAN IV for the IBM 7094.
Author

N68-11851* General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 11: PERFORMANCE ASSESSMENT OF LOW THRUST SPACE GUIDANCE SYSTEMS, VERSION 2
15 Feb. 1967 151 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 11) CFSTI: $3.00 CSCL 17G

This document describes a digital computer program developed to simulate the performance assessment of low thrust aided-inertial guidance and navigation systems. The description contains a mathematical model, a computer program description and an operator's and programmer's guide. The program is written in FORTRAN IV for the IBM 360/50 computer system.
Author

N68-11902*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FACTORS AFFECTING THE DESIGN AND USE OF A PHOTOGRAPHIC SEXTANT FOR SPACE NAVIGATION
Thomas M. Walsh Washington Dec. 1967 37 p refs
(NASA-TN-D-4285) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A study was made of design and use factors that are pertinent to the fabrication of a photographic instrument for obtaining sextant-type data and for providing target star identification information. The objective was to adapt the highly accurate techniques of astronomical photography and film readout to the space cabin environment. Of all the factors studied, the film was the most critical. Currently available emulsions lack either resolution, speed, or ease of development. Improvements in this area are expected and in the near future there should be no serious obstacles to sextant feasibility. However, current emulsions, if made available on flat glass plates, will suffice for sextant measurements that do not require landmark targets. Five basic sextant configurations are examined and one hardware concept is presented. A photographic sextant should be considered a serious alternative as a navigation instrument with a probable precision of better than 10 seconds of arc, with the added capability of providing data for target star identification.
Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-11016# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. DESIGN, FABRICATION, AND INITIAL OPERATION OF EXP-WR1-951 FUEL STRING
A. F. Lillie 31 Aug. 1967 48 p refs Prepared jointly with Combustion Engineering, Inc.
(Contract AT(38-1)-430)
(AI-CE-44) CFSTI: HC $3.00/MF $0.65

The EXP-WR1-951 fuel string is the first in a series of SAP clad–hyper UC irradiation tests to be performed by the HWOCR program in the WR-1 reactor. The design, analysis and fabrication of the test assembly are described. The initial operating performance is discussed. Comparison of these data with design conditions indicates that test performance is well within design margins.
NSA

N68-11023# Argonne National Lab., Ill. Reactor Physics Div.
RABBLE, A PROGRAM FOR COMPUTATION OF RESONANCE ABSORPTION IN MULTIREGION REACTOR CELLS
P. H. Kier and A. A. Robba Apr. 1967 44 p refs
(Contract W-31-109-ENG-38)
(ANL-7326) CFSTI: HC $3.00/MF $0.65

A method of computing resonance absorption in either slab or circularized reactor cells is developed and used to write a FORTRAN program, RABBLE, for the CDC-3600. Since the method uses space- and lethargy-dependent slowing-down sources, the program is well suited for the computation of resonance absorption when the effects of overlapping between resonances is significant. The cell is divided into regions, and the energy range of interest is divided into extremely narrow groups. Regional reaction rates are obtained from the slowing-down sources, first-flight transmission and escape probabilities, and interface currents. These regional reaction rates are accumulated over specified numbers of groups to yield effective cross sections. RABBLE allows for five compositions, which can be divided into 20 regions. There can be 12 nuclides, all of which can be resonant absorbers. The sum of the resonances is limited to 800. Effective cross sections and average fluxes are edited for up to 1000 intermediate groups and 25 broad groups. The number of the groups per intermediate group and the number of intermediate groups per broad group are broad-group dependent.
NSA

N68-11068*# National Aeronautics and and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF MEASURED AND MONTE CARLO CALCULATED GAMMA DOSE IN THE TUNGSTEN WATER-MODERATED CRITICAL ASSEMBLY

Paul Klann and Walter Paulson Washington NASA 1967 16 p refs Presented at the Winter Meeting on the Am. Nucl. Soc., Chicago, 5–9 Nov. 1967

(NASA-TM-X-52358) CFSTI: HC$3.00/MF$0.65 CSCL 18J

A Monte Carlo digital program, ATHENA, was developed and used to calculate the rate of gamma heat deposition in the Tungsten Water-Moderated Nuclear Rocket as a function of position. The results were compared and evaluated against measurements of the gamma dose throughout the core of the Tungsten Water-Moderated Reactor (TWMR) mockup critical assembly. Data curves are given. The TWMR critical assembly is briefly described; and schematic cross sectional diagrams of the assembly, fuel element, and graphite ionization chamber are depicted. L.S.

N68-11143 United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

MARINE NUCLEAR REACTORS

S. Rigg and J. Kay 1967 35 p Presented at the Branch Meeting of the Inst. of Mech. Engr., Barrow, England, 1 Dec. 1966

(TRG-1500(R)) HMSO: 4s 6d

This report reviews the current state of progress made internationally in the development of nuclear power for marine propulsion units, stressing the economic factors influencing this development and outlining the technical factors involved. A typical pressurised water reactor incorporating a burnable-poison core and integral heat exchanger suitable for marine use is described and the main parameters for a 71 MW(H) reactor are listed. The main features and philosophy of the design, and development potential are then discussed. The effects of the particular requirements for the use of nuclear propulsion units on the design of the ship and its machinery, and economic comparisons with conventional methods of propulsion for various marine applications are also considered. Author

N68-11184 United Kingdom Atomic Energy Authority Warkington (England). Reactor Group.

THE NON-DESTRUCTIVE TESTING METHODS FOR REACTOR FUEL ELEMENT TUBING

J. Rooney 16 Jan. 1967 24 p refs

(TRG-1427(S)) CFSTI: $3.00

Three methods have been developed for examining reactor fuel element tubing. The eddy-current method and the associated equipment which have been developed are described: the method presents a high-speed inspection technique. The ultrasonic method has been developed to provide uniform high sensitivity across the tube wall, on small-diameter tubing. Radiography is used to identify certain types of defect located by the other methods. Author

N68-11194* General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.

CAVITY REACTOR CRITICAL EXPERIMENT, VOLUME I Final Report

G. D. Pincock and J. F. Kunze 6 Sep. 1967 373 p refs

(Contract C-67747-A)

(NASA-CR-72234) CFSTI: $3.00 CSCL 18K

A series of experiments were conducted on a large reactor consisting of a cavity 183 cm in diameter of 122 cm long surrounded by 91 cm of heavy water. The cavity was fueled with uranium-235. Measurements were made on various configurations, including such variations as fuel diameter and shape, beryllium baffles in the reflector and insertion of various structural and operating materials characteristic of a nuclear rocket reactor. Author

N68-11382# Minnesota Mining and Mfg. Co., St. Paul, Minn.

SNAP-21 PROGRAM. PHASE 2: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM Quarterly Report, Apr. 1–Jun. 30, 1967

1967

F. K. Fox Jul. 1967 139 p

(Contract AT(30-1)-3691)

(MMM-3691-20; QR-4) CFSTI: HC$3.00/MF$0.65

Progress is reported on the SNAP-21 system design study. The generator A10D-z was completely assembled and found to have some fiberglass insulation sleeving short circuits which were corrected. Weld closures and insulation system were completed. Radiation effectiveness of the biological shield was determined using a 200 W ^{90}SrO source. 214 couples including both the instrumented types and those with output tap assemblies were fabricated. Development work is continuing to improve the physical strength of the bond of the N- and P-leg couples during bonding through improved fabrication techniques. Test plans for compatibility testing of multi-layer insulation were completed, the test fixture was designed, and 500 of the 2000 hrs of testing were accomplished. Tests concerning the relationship between degradation in the resistance of the bias section of the thermopile and the starting characteristics of the power conditioner showed that the power conditioner operating at the rated load with a degradation of 2:1 in the thermopile bias section will not inhibit starting under normal operating load. Test sections for the electrically heated fuel capsules, laboratory corrosion specimens and the galvanic and marine fouling system components were fabricated. The results of ultrasonic tests on the first weld development closures on fuel capsules were evaluated. Some cold end heat transfer tests were completed. Conceptual drawings of the 20 W system were started. An updated design envelope for the 20 W high vacuum thermal insulation system was prepared. The thermoelectric leg geometry was determined to establish the size of the generator. NSA

N68-11478# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THERMOCOUPLE DEVELOPMENT FOR THE FAST-FLUX TEST FACILITY

C. E. Huck 21 Aug. 1967 11 p refs Presented at 22d Instr.-Automation Conf. and Exhibit, Chicago

(Contract AT(45-1)-1820)

(BNWL-SA-1227; CONF-670903-11) CFSTI: HC$3.00/MF$0.65

Twenty-four thermocouples of various types were assembled into two fuel pin-size capsules, BT-1 and BT-2, and are now being exposed to a neutron flux density level of about 10^{15} nv in EBR-II. The purpose of the tests is to determine the effects of exposure of several types of thermocouples to fast neutron fluences of about 3×10^{22} nvt, along with the concurrent effects of high temperatures and high gamma radiation fields expected to be encountered in about one year of FFTF operation. Chromel/Alumel, Geminol-P/Geminol-N, platinum/platinum-10% rhodium, tungsten/tungsten-26% rhenium, and tungsten-5% rhenium/tungsten-25% rhenium thermocouples are included in these tests. Prior to insertion in EBR-II, the thermocouples were subjected to a series of laboratory materials verification, response time, and emf calibration tests. The response time and calibration tests will be repeated in a hot cell after irradiation to determine transmutation and other effects occurring from irradiation in the reactor. The Chromel/Alumel and Geminol thermocouples are candidate thermocouples of interest for FFTF sodium coolant temperature measurements. The platinum and tungsten alloy thermocouples were included primarily because of availability for the early development of laboratory and hot cell handling techniques. Author (NSA)

N68-11479# Army Materials and Mechanics Research Center, Watertown, Mass.

A FACILITY FOR THE STUDY OF NEUTRON MODERATION AT CRYOGENIC TEMPERATURES IN A LIGHT WATER POOL NUCLEAR REACTOR

John J. Antal, Arthur F. Landry, and Albert A. Warnas Aug. 1967 24 p refs
(AMMRC-TR-67-01; AD-659801)

Holding a small amount of moderator material at very low temperatures in a nuclear reactor provides a very useful source for the production of high-intensity low-energy neutron beams, which beams are employed in studies concerning the solid and liquid structural state of materials. Since very little is known of the factors affecting the efficiency of such sources, an experimental facility has been placed in operation to study various parameters, particularly the spatial distribution of the cold moderator. The facility and its design and operation are described, with emphasis on problems created by the addition of a nuclear radiation field to the cryogenic environment. The results of initial studies on the moderation of neutrons by solid methane at 84K are presented. Author (TAB)

N68-11497# Aktiebolaget Atomenergi, Stockholm (Sweden).
THE MEASUREMENT OF EPITHERMAL-TO-THERMAL U-238 NEUTRON CAPTURE RATE (ρ 28) IN ÅGESTA REACTOR FUEL
G. Bernander Sep. 1967 43 p refs
(AE-299) CFSTI: HC $3.00/MF $0.65

The epithermal-to-thermal neutron capture rate ratio ρ_{28} in U-238 in Agesta fuel has been measured by the chemical separation method. The method involves the isolation of Np-239 from uranium and fission products by reversed phase partition chromatography. Although somewhat elaborate, and in spite of difficulties with residual fission products, the method has yielded reasonably accurate results. The separation of the epithermal U-235 activation from the total has been achieved by means of the "1/v subtraction technique" using copper foils as the 1/v monitor. The complementary thermal column irradiations required have been performed in the research reactors TRIGA (Helsinki) and R1 (Stockholm). From the measured ρ_{28} values the resonance escape probability (p) and the initial conversion ratio (ICR) may be calculated using cross-section data and other lattice parameters. Comparisons with theoretical values of p and ICR as calculated with the BURNUP lattice parameter code are favorable. Author

N68-11529# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
SOME CONSIDERATION ON GAS COOLING FOR FAST BREEDERS
M. Dalle Donne, E. Eisemann, and K. Wirtz May 1967 15 p refs
(KFK-595)

Extrapolations of a high-temperate, He-cooled, thermal power reactor to a high-temperature, He-cooled, fast breeder power reactor of 21 MW(e) output is discussed. Problems of materials research, especially for fuel element cladding, are considered. Comparisons are made between steam cooling and He-cooling. A steam-cooled reactor appears to require less component development work than the He-cooled, because of turbine problems. Capital, operating, and breeding economics are studied. NSA

N68-11534# Los Alamos Scientific Lab., N. Mex.
ADVANCED PLUTONIUM FUELS PROGRAM Quarterly Status Report, Apr. 1–Jun. 30, 1967
30 Aug. 1967 93 p refs
(Contract W-7405-ENG-26)
(LA-3745; QSR-4) CFSTI: HC $3.00/MF $0.65

The experimental program is concerned with the effects of long-time contact between trace-irradiated, Pu-containing fuels and 500° to 700°C Na. A high-purity ternary alloy of Pu, Co, and Ce with a melting point near 435°C is used as a source of fission products for the transport and distribution in the Na loop experiment. The ranges of contamination levels found in Na and on stainless steel specimens for ^{90}Sr, ^{106}Ru, ^{125}Sb, ^{137}Cs, ^{144}Ce, ^{155}Eu, and ^{239}Pu are summarized. Sodium-coolant chemistry associated with the control of chemical reactions occurring in the Na coolant is investigated for the LMFBR program. The solubility of O_2 in Na using the vacuum–distillation analytical technique has been evaluated over the temperature range of 125° to 300°C. The Analytical Loop No. 1 has been modified and Analytical Loop No. 2 is being completed. The Na system for the cold trap characterization tests has been completed. Experiments determined the effect of cooling rate of a plugging orifice on the indicated plugging temperature. Phase equilibria and general properties, specific thermodynamic properties, free energy of formation in the 450 to 1200°C temperature range, and heat capacity and heat of transition are properties being investigated for Pu fuel materials. NSA

N68-11538# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
CALCULATION OF NEUTRON SPECTRA IN THERMAL REACTORS BY MEANS OF VARIOUS CODES [CALCOLO DI SPETTRI NEUTRONICI CON CONDICI ETEROGENEI IN REATTORI TERMICI]
F. Orestano and F. Pistella 1967 30 p In ITALIAN
(RT/FI(67)15)

In order to study and interpret experimental data on water moderated Pu lattices a particular method for neutron spectra evaluation has been developed by coupling different existing codes. Comparison between the experimental and calculated values relative to RANA and RITMO reactors is presented. Author (NSA)

N68-11542# Kernforschungszentrum, Karlsruhe. West Germany).
DETERMINATION OF REACTOR PHYSICS PARAMETERS FROM THE REACTOR NOISE BY ANALYSIS OF PROBABILITY DISTRIBUTIONS [BESTIMMUNG REAKTORPHYSIKALISCHER PARAMETER AUS DEM REAKTORRAUSCHEN DURCH ANALYSE VON WAHRSCHEINLICHKEITSVERTEILUNGEN]
Dieter H. Stegemann Jan. 1967 69 p refs In GERMAN
(KFK-542)

The determination of characteristics such as decay constant of prompt neutron flux, the neutron lifetime, the reactivity, and the absolute reactor power was determined from the analysis of the reactor noise. Difficulty lies in the development of new methods for the determination of probability distributions in the fast-thermal Argonaut reactor STARK. The theoretical principles of the method, beginning with the generalized equations, were treated in the approximation of the point reactor model. Two different methods were developed to obtain the reactor parameters desired from the measured probability distribution; first, the use of distribution moments, and second, the direct calculation of the distribution formed by the individual probabilities. A new type of probability distribution analyzer was developed for carrying out the experiments. Its construction and operation were described in detail. NSA

N68-11598# Atomic Energy Establishment, Winfrith (England).
METHOD OF ESTIMATING HYDROGEN IN SOLID AND LIQUID SAMPLES BY MEANS OF NEUTRON THERMALISATION
D. H. Carter and J. E. Sanders Jun. 1967 12 p
(AEEW-M-752) CFSTI: HC $3.00/MF $0.65

The count-rate of a cadmium-covered ^{239}Pu fission chamber placed in a reactor neutron flux increases when a hydrogen-containing material is inserted due to the thermalization of epicadmium neutrons. This effect forms the basis of a nondestructive method of estimating hydrogen in solid or liquid samples, and trial experiments to demonstrate the principles have been made. The sensitivity is such that hydrogen down to 10 ppM in a typical metal sould be detected. A useful feature of the method is its very low response to elemants other than hydrogen. Author (NSA)

N68-11878 Technische Hochschule München (West Germany).
SIMULATION AND CONTROL OF NUCLEAR PLANTS WITH NATURAL CIRCULATION BOILING WATER POWER REACTORS [SIMULIERUNG UND REGELUNG VON KERN-KRAFTWERKEN MIT NATURUMLAUF-SIEDENASSERREAK-TOREN]
Hilmar Jaschek [1967] 27 p refs In GERMAN
CFSTI: $3.00

Developed are mathematical models for simulating and regulating natural boiling water power reactor transients, its flow pipe system, and its turbine flow. Computer calculations established the performance parameters of the nuclear power reactor and selected the appropriate optimal fuel flow regulators. This model was then extended to cover forced boiling water reactors by keeping the circulation velocity independent from vaporization effects in the core and in the fuel ducts. Transl. by G.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-11092# Naval Research Lab., Washington, D. C.
A SYSTEM FOR MEASURING THE FIRST AND SECOND ORDER PROBABILITY DISTRIBUTIONS OF SIGNALS AND NOISE
Caldwell McCoy, Jr. and Herbert L. Peterson 11 Sep. 1967 34 p refs
(NRL-6522; AD-659957)

A system was designed and developed for use, either in the laboratory or field, to measure the first- and second-order amplitude-probability densities of signals and noise in the area of underwater acoustics. The system consists of a wide-band dc amplifier feeding a sample-and-hold network, followed by an analog-to-digital converter to encode the sampled instantaneous value to an amplitude resolution of ten-bits and sign. These digital codes become the address of a magnetic-core memory, and the value stored in a given address location is a tally for each time that address has been called up. Since the address was directed by the instantaneous amplitude value of a time function, the stored tallies are proportional to the amplitude density of that given time function when plotted out as a histogram. These measured values can be read into a general-purpose digital computer as desired to compute the normalized density function together with moments. This method of code sorting can be applied to other problems of instrumentation, e.g., calibration checks of analog-to-digital converters, stability of analog magnetic tape recorders, and drop-out measurements in analog magnetic tape recording. Author (TAB)

N68-11108* North Carolina State Coll., Raleigh.
A STUDY OF OPTICAL DATA PROCESSING AND REDUCTION Progress Report, Jul. 1–Dec. 31, 1966
1 Jan. 1966 52 p refs
(Grant NGR-34-002-038)
(NASA-CR-90237) CSCL 20F

Reports on completed work and recent studies are reviewed. A bibliography on optical information and data processing is described. Abstracted data on the effect of finite width of the dc-stop in optical correlators are included. A method of analytically determining the effect of internal nonlinearities on the output of a coherent optical correlator operated as a matched filter is presented. The method employs photographic transparencies or other media for the representation of the reference and signal functions. Hologram processing is also discussed, and general equations for the correlation functions of two hologram transmittance functions are derived. The holograms are those of point scatterers, one located at the origin, and the other arbitrarily displaced. The effects of the finite distribution of the recording element used for the conversion of a time function into a spatial function, and the effects of the finite time constants are mentioned. N.E.N.

N68-11209# Navy Underwater Sound Lab., New London, Conn.
DIFFRACTION THEORY OF LENSLESS CORRELATION
Eugene L. Green 17 Aug. 1967 19 p refs
(USL-842; AD-659966)

The two-dimensional lensless correlator is discussed on the basis of a diffraction theory that appears to be applicable to arbitrary functions. The analysis shows that this analog computer facilitates a continuous tradeoff of the number of multiplications contributing to the summation approximating a given integral with the number of summations computed. Applications of the lensless correlator to data processing are discussed and its limitations are indicated. Author (TAB)

N68-11235# Queens Coll., Flushing, N. Y. Dept. of Physics.
THE ORIES OF GRAVITATION
A. L. Harvy Oct. 1967 7 p refs
(Grant Nonr(E)-00018-67)
(TR-1; AD-660053)

It is shown that contrary to commonly held opinion the several Nordstrom theories of gravitation are not equivalent to generally covariant scalar theories set in conformally Flat Riemannian manifolds. Author (TAB)

N68-11250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONDITION OF PHASE MATCHING IN LIGHT-WAVE FREQUENCY CONVERSION [OB USLOVII FAZOVOGO SOLASOVANIYA PRI PREOBRAZOVANII CHASTOTY SVETOVYKH VOLN]
A. G. Khatkevich and B. V. Bokut' 28 Feb. 1967 9 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (USSR), v. 9, no. 6, 1965 p 357–359
(FTD-HT-67-31; TT-67-63130; AD-659911)

From a continuation of an earlier paper (DAN BSSR v. 8, no. 11, 713, 1964), the report gives a general solution for the problem of light-wave frequency conversion by crystals and shows that in general, 14 polarization waves are produced when two waves are incident on a nonlinear crystal. The present paper considers the possibility of phase matching of all these waves, wherein the vector of the polarization-wave refraction coincides with the vector of the generated-wave refraction. The necessary condition for the phase matching is derived and is shown to be related with the ratio of the birefringence and the dispersion. The analysis shows that phase matching is possible for nine different polarization waves, and the wave with the higher frequency (polarization or pumping waves) should have a lower refractive index. The possibility of phase matching in a uniaxial crystal is further considered, and it is shown that in the case when the ordinary beam from a ruby laser operating at 6934 A is mixed with the extraordinary beam from a CaWO4:Nd(3+) laser (10582 A in a KDP crystal, phase matching takes place at an angle of 54.6 degrees, whereas in the case when only the ordinary beams of these lasers are mixed the matching takes place at 42.6 degrees. Author (TAB)

N68-11350# Rochester Univ., N. Y. Inst. of Optics.
PERCEIVED BRIGHTNESS OF FLASHING POINT SOURCES
David Alan Naus (M.S. Thesis) 1967 47 p refs
(AD-660207)

The purpose of this research was to study further the perceived brightness of flashing point sources near and above threshold. Most recent work has been with sources having too large a size to be considered point sources. A stimulus size of a few minutes was desired. The method of Katz and Sturr was employed, making use of a 200 msec flash as a standard and investigating shorter flashes using both the co-terminating and co-beginning methods of presentation. Author (TAB)

N68-11412# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INVESTIGATION OF THE EFFECT OF ADJUSTING RESONATOR MIRRORS ON THE EMISSION PARAMETERS
A. P. Prishivalko and Ye. K. Kopanik 28 Feb. 1967 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 9, no. 10, 1965 p 654–658
(FTD-HT-67-28; TT-67-63135; AD-659905)

An approximate method was employed elsewhere to calculate the luminescence in a cavity resonator. The method was later generalized to include the more general and specifically important case of a resonator with external plane mirrors, with both the nonparallel attitude of the rod ends and the possible misalignment of the mirrors taken into consideration. The present article reduces the problem of finding the gain and yield of the resonator under steady-state conditions. The present paper investigates the effect of the air gap and the mirror misalignment angle on the gain and yield emitted through the resonator base. The study of the dependence on the gain (which becomes stabilized under steady-state conditions) provides the data required for the determination of the various types of losses in the resonator, calculation of noise, and the angular structure of the radiation. Author (TAB)

N68-11470# Seattle Univ., Wash. Dept. of Electrical Engineering.
TRANSIENT WAVE PROPAGATION IN A CONDUCTING MEDIUM
B. L. Jaganmohana Rao and Akira Ishimaru May 1967 63 p refs
(Contract AF 19(628)-5879)
(AFCRL-67-0384; SR-3; TR-117; AD-659759)

Approximate solutions are obtained for the transient fields in an infinite or semi-infinite conducting medium excited by a step-modulated sinusoidal plane wave. A saddle point method is used to obtain a solution which is valid for relatively large times in the transient response, and a series expansion method is used to obtain a solution which is valid for small times in the transient response. A brief discussion is included on the signal velocity in a conducting medium. Author (TAB)

N68-11551 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COEFFICIENT OF EFFICIENCY OF A GROUND EXPLOSION [O KOEFFITSIYENTE POLEZNOGO DEYSTVIYA VZRYVA V GRUNTE]
V. M. Kuznetsov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 37–42 refs (See N68-11548 02-34)

It was revealed that effectiveness of an explosion in a hard medium may be significantly increased by special charges with air gaps. This phenomenon was explained by the fact that air gaps decrease power consumption of the explosion through unnecessary overcrushing and overcompression of rocks near the charge and thereby increase the fraction of usefully utilized energy. A theoretical explanation of this phenomenon was given, proceeding from the assumption that the final stage of development of the explosion in the ground is close to static. It is known, however, that in a number of cases, for instance at an explosion in soft ground, pressure at the end of expansion of the cavity may be less static due to motion of the medium. It is interesting to estimate what influence this circumstance has on the magnitude of optimum energy density and the useful action coefficient of the explosion. Author

N68-11552 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPLOSIVE WAVES IN LOESS-LIKE GROUND [VZRYVNYYE VOLNY V LESSOVIDNOM GRUNTE]
S. S. Grigoryan, G. M. Lyakhov, V. V. Mel'nikov, and G. V. Rykov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 43–48 refs (See N68-11548 02-34)

Certain works describe a method of measurement of blast waves in soft grounds and give some results of such measurements conducted in sandy ground. By this method, enriched by measurement of mass velocities of particles, experiments were conducted in loess in the odessa region. This article gives some of the results of these experiments and discusses them. Author

N68-11586* New York Univ., N. Y.
ANNUAL PROGRESS REPORT, SEPTEMBER 1, 1965–AUGUST 31, 1966
Fred Landis 30 Sep. 1966 91 p refs
(Grant NGR-33-016-067)
(NASA-CR-90230) CSCL 20

Fluid mechanics, solid mechanics, and space physics research efforts are summarized, as are studies dealing with the impact of space technology on the community. Programs deal with boundary layers, radiative gas flows, variational solutions, hydrodynamics, gas-crystal surface collisions, gas mixture properties, and plasma physics dynamic fields. Soft filaments interconnected with beams, plates, and shells are under investigation; as are elastic, plastic, elastoplastic, and viscoelastic responses of various structures and systems. The man body problem and astrophysics is being investigated; along with multiphoton ionization, solar lines, remote control micromanipulators, fuel cell electrode photocurrents, genetic changes induced by laser irradiation of drosophila melanogaster, and dynamic factors in human perception. M.W.R.

N68-11616# Brookhaven National Lab., Upton, N. Y.
MEASUREMENT OF Q OF SUPERCONDUCTING TE_{011} CAVITIES BY FREQUENCY SWEEP TECHNIQUE
H. Hahn, H. J. Halama, and E. H. Foster [1967] 17 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(BNL-11702; CONF-670930-1) CFSTI: HC $3.00/MF $0.65

A frequency sweep technique for Q measurements of superconducting cavities is described. A fast adiabatic passage through resonance shock-excites the cavity which relaxes afterwards in the form of decaying eigen oscillations. The procedure suggested permits measurements with negligible effects due to rf heating or electrical breakdown. It is suggested to use a transmission-type cavity and to measure the relaxation process of the cavity directly. The theory, which is developed in the paper, indicates that the loaded Q can be determined from the relaxation time and the coupling coefficient from the amplitude of the output signal. The frequency sweep technique has been applied to Q measurements of a superconducting TE_{011} cavity resonant at 2.868 GHz. The cavity is made of OFHC copper on which a 2.5 μm lead layer is electroplated from a lead fluoborate bath. An unloaded $Q_0=(196\pm15)\times10^6$ at 4.2°K was measured. Possible systematic errors were examined and were found to be inconsequential. The temperature dependence of Q_0 was also determined. Author (NSA)

N68-11624* Michigan Univ., Ann Arbor. Radiation Lab.
ELECTROMAGNETISM IN MOVING, CONDUCTING MEDIA
Rudolph M. Kalafus Dec. 1966 109 p refs
(Grant NGR-23-005-107)
(NASA-CR-90492; Rept.-7322-3-T) CFSTI: $3.00 CSCL 20C

Based on Minkowski's theory of the electrodynamics of moving bodies, the present work is concerned with the systematic solution of problems involving sources placed in a uniformly moving, conducting medium. To accomplish this, two differing forms of Ohm's law for moving media were examined and it is concluded that: (1) the two forms are equivalent and interchangeable, and (2) that their apparent differences arises out of different definitions of conduction and convection currents. Another difficulty which is encountered when dealing with conducting media is related to the relaxation phenomenon. A scheme is developed here which involves a separation of currents and charges into source and response terms. The source terms can be specified independently, but the total charge must be consistent with Maxwell's equations. Vector and scalar potentials are developed from the field quantities, and partial differential equations for the potentials are derived for two classes of problems: static charge sources, and harmonic current sources. For unbounded regions potential solutions are found by the method of Green's functions, which satisfy the same differential equations. The differential equations are solved by transform methods, and the Green's functions are found in closed form. The medium is assumed to have constant scalar parameters of permittivity, permeability, and conductivity. Results are valid for all values of conductivity and frequency, and for relativistic velocities.
Author

N68-11661 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS
19 Apr. 1967 408 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1964 p 1–160
(FTD-HT-66-261; TT-67-63189; AD-660248)

Papers studying plasma properties, combustion mechanics, shock wave phenomena, and flame propagation are given. For individual titles, see N68-11662–N68-11694.

N68-11695# California Inst. of Tech., Pasadena.
ALBERT: A PACKAGE OF FOUR COMPUTER PROGRAMS FOR CALCULATING GENERAL RELATIVISTIC CURVATURE TENSORS AND EQUATIONS OF MOTION
Kip S. Thorne and Barbara A. Zimmerman Aug. 1967 83 p refs
(Contract Nonr-220(47); Grant NSF GP-5391)
(AD-660044)

This report is a users manual for ALBERT, a package of four Caltech computer programs which calculate analytic expressions for general relativistic curvature tensors and equations of motion. The input data for ALBERT are analytic forms for the covariant and contravariant components of the metric tensor, g subscript ab and g superscript ab, and for the mixed components of the stress-energy tensor, W subscript a, superscript b. The output, variable at the discretion of the user, includes analytic expressions for the equations of motion, W subscript a, superscript b; subscript b = 0; for the Christoffel symbols, (Gamma subscript abc) and (Gamma subscript ab superscript c); for the Riemann tensor, R subscript abcd; for the Ricci tensor, R superscript a subscript b; for the Einstein tensor, G superscript a subscript b; and for the Ricci scalar, R. ALBERT should be usable, without modification, on any computer which has a FORMAC compiler. A complete listing of the programs in ALBERT is included in this report.
TAB

N68-11705# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
A NOTE ON CAUCHY'S THEOREM
Morton E. Gurtin, Victor J. Mizel, and William O. Williams Jun. 1967 6 p refs
(Contract Nonr-51031)
(Rept.-67-23; AD-656923)

Cauchys fundamental theorem, which in the framework of mechanics gives the existence of a stress tensor, is established under very weak hypotheses.
Author (TAB)

N68-11863*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM (OTES), VOLUME 2 Final Report
15 Sep. 1967 305 p Prepared jointly with Perkin-Elmer Corp.
(Contract NAS8-20255)
(NASA-CR-90529; Rept.-8900, V. 2; LMSC-A648294, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Conceptual designs (structural, thermal control, electrical power, attitude-control, and communications subsystems) were generated for a manned Optical Technology Extension System (OTES). The proposed spacecraft will use a 2-m diameter, seven-segment, active optics primary mirror telescope system, and will mate with the Apollo Telescope Mount (ATM) rack. The OTES primary mode of operation will be on the AAP Cluster X. Tradeoff studies of the advantages and disadvantages of the various approaches led to selection of a preferred conceptual design. A preliminary analysis of the OTES structural system reliability was performed, and it was determined that NASA goals for AAP reliability and crew safety can be achieved with the preferred conceptual design. Reliability assurance activities for the subsequent phases of OTES development were also evaluated. In addition, the preferred design was examined to determine deployment techniques and compatibility with current planning for AAP cluster operations (including a preliminary examination of launch window constraints).
L.S.

N68-11864*# Perkin-Elmer Corp., Norwalk, Conn.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM (OTES), VOLUME 1
Oct. 1967 504 p
(Contract NAS8-20255)
(NASA-CR-90530; Rept.-8900, v. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A number of optical technology space experiments are identified, studied, and described in detail. Five different system concepts (vidicon imaging system, spectrometer, laser, optical telescope, and spectrograph) were evolved and examined for feasibility within the restraints and guidelines of the specification. Optical communications, and ground station requirements for the Optical Technology Apollo Extension System (OTES) are also described.
L.S.

N68-11895# Public Health Service, Cincinnati, Ohio. National Center for Air Pollution Control.
OPTICAL PROPERTIES AND VISUAL EFFECTS OF SMOKE-STACK PLUMES
William D. Conner and J. Raymond Hodkinson (Va. State Coll.) 1967 95 p refs
(PUB-999-AP-30; PB-174705) CFSTI: HC $3.00/MF $0.65

Two experimental smoke stacks were constructed to provide test plumes for studies of optical properties and visual effects over a wide range of illuminating and viewing conditions. Results indicate that visual effects are not intrinsic properties of the plumes but vary with the background of the plume and with illuminating and viewing conditions. Variation was much greater with white plumes than with black. Tests conducted with trained smoke inspectors showed that their evaluations of nonblack smoke plumes were significantly influenced by these variations. The angular scattering and transmission characteristics of the experimental plumes were measured and estimates of particle size derived therefrom. The study shows that the quantity of aerosols in a plume is best evaluated optically by its transmittance. Special methods for measuring the transmittance of smoke plumes objectively are

discussed. The methods involve telephotometry, photography, and photometry of targets; the use of smoke guides; and laser measurements. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-11037*# New York Univ., N. Y.
QUANTUM MECHANICAL STUDY OF MOLECULES TRANSITION PROBABILITIES, EINSTEIN A COEFFICIENTS AND OSCILLATOR STRENGTHS OF SOME BAND SYSTEMS OF DIATOMIC MOLECULES
D. C. Jain and R. C. Sahni Washington NASA Dec. 1967 45 p refs
(Grant NsG-76)
(NASA-CR-975) CFSTI: HC$3.00/MF$0.65 CSCL 20H

The Franck–Condon factors and *r*-centroids based on the Rydberg–Klein–Rees potential energy curves, have been presented for some band systems of the CO^+, N_2, N_2 and RbH molecules. The variation of the electronic transition moment with the internuclear distance, $R_e(r)$, has been determined by the *r*-centroid procedure for the band systems for which the experimental data on the relative intensity distribution is available. The absolute band strengths, Einstein A coefficients and oscillator strengths have been obtained for some band systems by employing the expression for the electric dipole transition moment, $R_e(r)$, and the lifetimes of the excited states. The influence of the vibration–rotation interaction on the transition probabilities of the band system of the RbH molecule was studied and it was found that for this and certain other similar band systems, the vibration–rotation interaction must be included in the theoretical interpretation of the results. The importance and possible applications of these results is also described. Author

N68-11051 Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
THE LEVEL-CROSSING EFFECT IN SODIUM AND POTASSIUM
William Eric Baylis (Ph.D. Thesis) Jul. 1967 120 p refs
(MPI-PAE/EXTRATERR-9/67)

Theoretical level-crossing curves were calculated for the $^2P_{3/2}$ state of atoms with nuclear spin of 3/2. The curves were calculated for various values of the product of lifetime and magnetic dipole and of magnetic dipole/electric quadrupole ratio. It was shown that incident light linearly polarized perpendicular to the magnetic field can cause alignment and orientation of the ground-state spin; the resulting effects on the level-crossing curves were also calculated. It was furthermore shown that for the level-crossing curves considered, radiation trapping is overshadowed by a decrease in signal strength. Level-crossing measurements were made on sodium and potassium, and are compared with the theory. The effects of radiation trapping and collisions with Ne atoms were also investigated. The strength of the level-crossing signal was found strongly dependent on the maximum at about 10^{-6} torr. From the sodium level-crossing signal in the presence of neon, a cross section of $150 \pm 50 \times 10^{-16}$ cm^2 was determined for $^2P_{3/2}$ mixing collisions. Author

N68-11074*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCATTERING OF 42-MEV (6.7-PJ) ALPHA PARTICLES FROM EVEN ISOTOPES OF CADMIUM
Norton Baron, Regis F. Leonard, and William M. Stewart Washington Nov. 1967 19 p refs
(NASA-TN-D-4256) CFSTI: HC$3.00/MF$0.65 CSCL 20H

Angular distributions were measured for the elastic and inelastic scattering of 42 MeV (6.7-pJ) alpha particles from isotopically enriched targets of cadmium 110, 112, 114, and 116. In each isotope, five excited states were seen and their excitation energies were determined to ±30 keV (±4.8 fJ). Angular distributions for three of these states were measured over the angular range 30° to 65°. Their relative phases and excitation energies indicate that these states are the first 2^+, the 3^-, and the two phonon 2^+. It is suggested that the two other excited states result from a quadrupole-octupole two-phonon transition. A tentative spin assignment of 5^- was made for one of them. Elastic angular distributions were analysed using the optical model with a four parameter Woods-Saxon potential. Excellent fits have been obtained for the elastic scattering. Inelastic scattering has been analyzed using a distorted wave Born approximation calculation. These calculated inelastic angular distributions agree very well with the experimentally measured cross sections for scattering to one phonon states, and allow determination of deformation parameters which are in satisfactory agreement with those obtained elsewhere. Author

N68-11096# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
EFFECTS OF COHERENCE IN ELECTROMAGNETIC RADIATION Final Report, Mar. 1, 1965–Aug. 31, 1967
Emil Wolf Sep. 1967 20 p refs
(Grant AF-AFOSR-237-65)
(AFOSR-67-2238; AD-660124)

The report summarizes researches concerned with theoretical studies of coherence effects in electromagnetic fields, with special reference to the electromangetic range of the spectrum. Various properties of fluctuating fields were investigated and second and higher order coherence effects were analyzed. Relation between the classical and quantum theory of coherence was also considered. A degree of coherence of arbitrary order was introduced which has some advantages over that introduced earlier by other authors. Further, diagonal coherent state representation of quantum operators was studied. Some related investigations in statistical mechanics, and in diffraction theory of the electromagnetic field were also carried out. Author (TAB)

N68-11102 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
COMPUTATION OF THE DIFFERENTIAL CROSS-SECTION FOR KNOCK-OUT REACTION (PLANE WAVES APPROXIMATION ACCORDING TO W. TOBOCMAN METHOD). THE PROGRAM FOR THE COMPUTER UMC-1 [WYLICZANIE ROZNICZKOWEGO PRZEKROJU CZYNNEGO NA REAKCJE WYBICIA (PRZYBLIZENIE FAL PLASKICH WEDLUG METODY W. TOBOCMANA). PROGRAM DLA MASZYNY CYFROWEJ UMC-1]
Maria Makowski-Rzeszutko May 1967 40 p refs In POLISH; ENGLISH summary
(INP-545/PL)

Formulas and computer programs for computing the differential cross-section for $^{12}C(d,\alpha)^{10}B$ reaction are developed. A description, instructions, and a practical example of the program are presented. Author

N68-11162# Naval Research Lab., Washington, D. C.
SCREENED COULOMB FORMULATION OF THE IONIZATION EQUILIBRIUM EQUATION OF STATE
Carl A. Rouse 18 Sep. 1967 22 p refs
(NRL-6594; AD-659948)

The ionization equilibrium equation of state (IEEOS) is formulated relative to the numerical solutions of the Schrodinger equation with the complete screened Coulomb potential (CSCP). A finite electronic partition function and the change in ionization

potential with screening radius--the radius of the mean atomic volume--which have been derived elsewhere, are used in the authors modification of the Saha equation. The resulting IEEOS is used for hydrogen and iron, where pressures at high densities and temperature are compared with pressures from the equation of state based upon the Thomas-Fermi-Dirac (TFD) statistical model of the atom. The present formulation is completely independent of TFD results; yet it gives very good agreement, for monatomic elements of all Z, with TFD pressures at high densities and temperatures, where the TFD results are believed to be reasonable; at low temperatures and densities, where the TFD pressures are either much too high or negative, the IEEOS yields the correct monatomic limit. Furthermore, in the region with T approximately equal to 1 eV and rho approximately equal to rho sub zero, the normal solid-liquid density, the IEEOS pressures are in good agreement with experimental extrapolations. Consequently, since mixtures of monatomic elements can also be handled with equal ease, the present IEEOS represents a significant improvement over the TFD equation of state. Author (TAB)

N68-11182# Naval Radiological Defense Lab., San Francisco, Calif.
ANGULAR DISTRIBUTIONS OF GAMMA RAYS FROM NEUTRON INELASTIC SCATTERING: COMPARISON OF THEORY AND EXPERIMENT
James M. Ferguson 28 Aug. 1967 28 p refs
(USNRDL-TR-67-108; AD-660363)

Various theoretical and experimental angular distributions of gamma rays from neutron inelastic scattering are intercompared. In comparing various angular distributions calculated from compound nucleus theory, it is shown that the shape of the distribution is quite independent of the details of the theory. The shapes for various sets of theoretical parameters and conditions are essentially indistinguishable. Further, it is found that the rather extensive available data agree with the theory, within the accuracy of the data. Only the shapes and not the magnitudes are considered. Author (TAB)

N68-11223# California Univ., Berkeley.
A FINITE ELECTRONIC PARTITION FUNCTION FROM SCREENED COULOMB INTERACTIONS
Carl A. Rouse Washington NRL 15 Sep. 1967 35 p refs
Sponsored by ONR and NSF
(NRL-6556; AD-659953)

Some numerical solutions of the Schrodinger equation with the complete screened Coulomb potential (CSCP) have been presented with tables and graphs of quantum numbers lambda(subscripts n, l) and relative normalizations phi(subscripts n, l) (lambda). The problem of a maximum bound principal quantum number or a finite number of screened Coulomb states has been resolved: the screened Coulomb potential yields at least as many bound states as the Coulomb potential. The concepts and results introduced here also resolve the problem of the intensity drop of hydrogen lines in the solar photosphere and chromosphere and in very low temperature hydrogen in laboratory measurements. The effect of screening on the lowering of the ionization potential of an atom is illustrated by the calculation of the observed ionization potential of hydrogen as accurately as it is calculated by more elaborate methods. Astrophysical observations of effective maximum bound states and/or maximum distinct levels will enable one to calculate an ion-number density in the source of absorption or emission lines. This will be valuable in obtaining more information about the atmospheres of stars in general, and quasi-stellar objects and X-ray sources in particular, as well as local density variations in the atmosphere of the sun. And, of course, with a given relative abundance of elements, a mass density can be computed. TAB

N68-11275# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LCAO SECULAR DETERMINANT PROGRAM
Donald Esterling 12 Jul. 1967 21 p ref
(Contract AT 19(628)-5167)
(ESD-TR-67-328; TR-435; AD-659749)

The report describes a computer program designed to set up the secular determinant arising from an energy band calculation in the LCAO (Linear Combination of Atomic Orbitals) approximation. The program determines which transfer integrals vanish, and which are related; further, it computes the appropriate structure factor (which contains the momentum dependence) for each entry in the secular determinant. This program can handle arbitrary crystal symmetry, unit cells with many inequivalent atoms, interactions involving up to fourth-nearest neighbors, and a choice of s-, p-, and/or d-orbitals on the various inequivalent atoms. The transfer integrals are left as parameters to be determined from the eigenvalues corresponding to special symmetry points in the Brillouin zone. Author (TAB)

N68-11303# California Univ., Berkeley. Lawrence Radiation Lab.
O(4) SYMMETRY AND REGGE POLE THEORY
Jiunn-ming Wang (Ph.D. Thesis) 27 Jul. 1967 50 p refs
(Contract W-7405-ENG-48)
(UCRL-17738) CFSTI: HC$3.00/MF$0.65

For reactions in which the initial and final states in the t-channel contain equal-mass particles (e.g., $N\bar{N}\rightarrow\pi\pi$) of masses m and m', it is shown using analytic continuation and Lorentz invariance that the on-mass shell helicity amplitudes in the region $t=0$, $(m-m')^2\leq s\leq(m+m')^2$, are invariant under the group O(4). Decompositions of the amplitudes in irreducible representations of O(4) (four dimensional partial wave expansions) are obtained and related to conventional partial wave expansions. Poles classified according to the O(4) group are shown to lead to infinite families of Regge poles. The formalism is developed for arbitrary spins and the case of nucleon--nucleon scattering is studied in detail. The results for the Regge pole structure in NN scattering are stronger than those of the conspirator theory. Author (NSA)

N68-11304# California Univ., Berkeley. Lawrence Radiation Lab.
π^--^{4}He INELASTIC AND CAPTURE REACTIONS LEADING TO EXCITED AND MULTI-NEUTRON FINAL STATES
Leon Kaufman (Ph.D. Thesis) 1 Aug. 1967 85 p refs
(Contract W-7405-ENG-48)
(UCRL-17605) CFSTI: HC$3.00/MF$0.65

A beam of 140±0.5-MeV π^- was produced at the Berkeley 184-inch cyclotron and was used to study final-state interactions of three and four neutrons, and to look for excited levels of the α particle through the reactions $\pi^-+{}^4He\rightarrow\pi^-+{}^4He^*$, $\pi^-+{}^4He\rightarrow p+3n$, $\pi^-+{}^4He\rightarrow d+2n$, and $\pi^-+{}^4He\rightarrow\pi^++4n$. Only one such level is found, with an excitation energy of 32 MeV and an intrinsic width smaller than the 1-MeV resolution used. It was found that the data on the four-neutron final state are best fit by considering two neutrons interacting through a $^1S_0$ potential, and the two other neutrons as spectators. It was also found that deuteron production is down by a factor of $\approx10^3$ from proton production and that the proton spectrum shows a stronger than expected interaction between the energy of 32 MeV and an intrinsic width smaller than the 1-MeV resolution used. It was found that the data on the four-neutron final state are best fit by considering two neutrons interacting through a $^1S_0$ potential, and the two other neutrons as spectators. It was also found that deuteron production is down by a factor of $\approx10^3$ from proton production and that the proton spectrum shows a stronger than expected interaction between the three neutrons in the final state. Lower limits for the production of a tri- or tetraneutron are set. Author (NSA)

N68-11305# California Univ., Berkeley. Lawrence Radiation Lab.
TOWARD A THOMAS-FERMI MASS FORMULA
William D. Myers 11 Aug. 1967 22 p refs Presented at the 3rd Intern. Conf. on Atomic Masses, Winnipeg, Can., 28 Aug.–1 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17725; CONF-670818-2) CFSTI: HC$3.00/MF$0.65

Nuclear properties—nuclear masses in particular—lend themselves to a two-part approach in which average properties and shell effects are treated separately. Recent improvements in treating the shell-effect part of nuclear masses have stimulated an investigation of corrections to the smooth part of the formula the liquid-drop-model part. The Thomas–Fermi statistical method is employed to calculate these corrections, and the coefficient of a $A^{1/3}$ term is discussed in detail. In addition, the nuclear density distributions are shown which arise in the course of the Thomas–Fermi calculations. Author (NSA)

N68-11342# Washington Univ., Seattle. Nuclear Physics Lab.
EXPERIMENTS ON ISOBARIC STATES IN NUCLEI
Peter von Brentano 1 Jul. 1967 43 p refs Presented at Sym. on Nucl. Phys., Tbilisi, USSR, 20–27 Apr. 1967
(Contract AT(45-1)-1388)
(RLO-1388-35)

A brief review is given on published literature dealing with isobaric analog states in medium and heavy nuclei. Discussions are presented on: isospin dependent effects in the form factor of bound states; experiments on delayed proton emission from analog states populated by direct reactions; nuclear structure information from resonant scattering through analog states; studies of particle-hole states via analog states; and spectroscopic factors. NSA

N68-11352# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics.
NUCLEAR DEFORMATIONS IN THE PAIRING-PLUS-QUADRUPOLE MODEL. 2: JUSTIFICATION OF THE MODEL
Michel Baranger and Krishna Kumar (Mich. State Univ.) Sep. 1967 81 p refs Submitted for publication
(Contracts Nonr-760(15); AT(11-1)-1051)
(TR-29; AD-660041)

The paper attempts to choose the parameters of the pairing-plus-quadrupole model to make it as realistic as possible. A correction is introduced to take into account the different numbers of neutrons and protons. An expression is given for the deformation energy of a nucleus with an arbitrary two-body interaction. Then the pairing-plus-quadrupole matrix elements are compared with those of more realistic interactions and it is decided to keep only matrix elements between states of two adjacent oscillator shells. An argument is given to determine a priori the strength of the quadrupole force and various corrections to this are discussed. No similar argument is found for the pairing force. Residual effects of the remaining oscillator shells are included in an approximate fashion. Comparison is made with previous work along these lines. Author (TAB)

N68-11387# Northeastern Univ., Boston, Mass.
HIGH ENERGY COLLISION PHENOMENA AND RELATED PROCESSES BY APPROXIMATE METHODS Final Report, 1 Sep. 1962–30 Jun. 1967
Bertram J. Malenka 30 Jun. 1967 16 p refs
(Contract DA-31-124-ARO(D)-345; Grants DA-ARO(D)-31-124-G304; DA-ARO(D)-31-124-G546)
(AROD-3246-18-P; AD-659804)

A summary is given of the results of a series of studies involving various aspects of nuclear particle interactions. A list of publications resulting from the work is included. TAB

N68-11391# California Univ., Berkeley. Lawrence Radiation Lab.
AN ANALYTICAL AND NUMERICAL STUDY OF THE BOUND-STATE SOLUTIONS TO THE PION–NUCLEON BETHE–SALPETER EQUATION
Klaus D. Rothe (Ph.D. Thesis) 24 Jul. 1967 151 p refs
(Contract W-7405-ENG-48)
(UCRL-17671) CFSTI: HC$3.00/MF$0.65

The Bethe–Salpeter equation is solved numerically for energies below the elastic threshold by use of variational techniques. Only the ladder approximation with a local potential corresponding to the exchange of an elementary nucleon is considered. The boundary conditions to be imposed on the solutions are examined in detail in order to lead to a discrete eigenvalue spectrum. The study of this problem is considerably simplified at zero total cm energy. In order to take full advantage of this symmetry, a new set of spinor spherical harmonics are constructed. The discussion is then extended to the general case, in which the formal structure of the $E \neq 0$ solutions is examined briefly. Attention is given to the role of the relative time in a relativistic theory, and the closely related problem of arriving at a time-independent approximation of the BS equation. In particular, the static and nonrelativistic limit of the equation is considered, and the validity of the approximations involved is discussed. Finally, a brief discussion is given of the $N\theta$ and $V\theta$ sectors of the Lee model. Author (NSA)

N68-11410 Nihon Univ., Tokyo (Japan). Atomic Energy Research Inst.
THE VECTOR MESON DOMINANT MODEL AND THE $K \rightarrow \pi e^+ e^-$ DECAY
S. Y. Tsai Sep. 1967 22 p refs
(NUP-A-67-15)

The $K \rightarrow \pi e^+ e^-$ decay is investigated under the vector meson dominant model of the electromagnetic interaction of hadrons. To the extent that this model describes the actual process, following results have been obtained: (1) the breakdown of the SU(3) symmetry at the photon-vector meson vertexes may be such that it enhances the γ–ω coupling strength but greatly reduces the γ–ϕ coupling strength; (2) the K–π weak vertex function is almost momentum independent; (3) the decay rates for $K^+ \rightarrow \pi^+ e^+ e^-$ and $K_1 \rightarrow \pi^0 e^+ e^-$ are equal; and (4) the branching ratio for $K^+ \rightarrow \pi^+ e^+ e^-$ turns out to be of order 10^{-10} Author

N68-11438# California Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENT OF THE POLARIZATION PARAMETER IN $\pi^+ P$ SCATTERING FROM 750 TO 3760 MeV/c
Claiborne Holt Johnson, Jr. (Ph.D. Thesis) Aug. 1967 159 p refs
(Contract W-7405-ENG-48)
(UCRL-17683) CFSTI: HC$3.00/MF$0.65

The polarization parameter in $\pi^+ p$ elastic scattering at fifteen lab momenta from 745 to 3747 MeV/c was measured. The positive pion beam was focused on a one-cubic-inch polarized proton target and both final-state particles were detected by scintillation counter hodoscopes. On the basis of their coplanarity and opening angle, elastic events involving polarized protons were distinguished kinematically from background events. The polarization parameter was obtained by observing the asymmetry in counting rates detected when the target was polarized successively parallel and antiparallel to the normal to the scattering plane. These results, combined with those of other experiments, are being used to conduct a phase-shift analysis of the pion–nucleon system at 19 energies from 490 to 1566 MeV (1443 to 2025 MeV total center-of-mass energy). Several comments about this analysis and a tentative solution are presented. This solution is not in disagreement with earlier analyses, but its uniqueness was not yet firmly demonstrated. Author (NSA)

N68-11441 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ENERGY SPECTRA OF LONG RANGE PARTICLES FROM THE THERMAL NEUTRON FISSION OF ^{235}U [WIDMA ENERGETYCZNE CZASTEK DLUGOZASIEGOWYCH EMITOWANYCH PODCZAS ROZSZCZEPIENIA ^{235}U NEUTRONAMI TERMICZNYMI]

M. Dakowski, J. Chwaszczewska, T. Krogulski, E. Piasecki, and M. Sowinski 1967 15 p refs Submitted for publication
(INR-822/IA/PL) CFSTI: $3.00

Energy spectra of ^{1}H, ^{2}H, ^{3}H, ^{4}He and ^{6}He from the thermal-neutron fission of ^{235}U have been investigated using a semiconductor counter telescope and two-parameter analysis. Gaussian distributions were fitted to the measured distributions with the least squares method. Relative intensities have been calculated. Author

N68-11442 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

FOUR-MOMENTUM TRANSFER DISTRIBUTION IN HIGH ENERGY, HIGH MULTIPLICITY REACTIONS [ROZKLAD PRZEKAZU CZTEROPEDU W PROCESACH WYSOKIEJ ENERGII I WYSOKIEJ KROTNOSCI]

G. Bialkowski and R. Sosnowski 1967 14 p refs Submitted for publication
(INR-833/VI) CFSTI: $3.00

The four momentum transfer distribution to the secondary nucleon in high energy, high multiplicity pion–proton interactions is discussed. It is shown that introducing corrections for the available phase space we obtain distributions of the four momentum transfer t in many body reactions similar to those for two body processes. Furtherdown it is demonstrated that the most characteristic features of high multiplicity π^{+}–p interactions at 8 GeV/c can be reproduced assuming that the transition matrix element for these interactions depends only on t. Author

N68-11443 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ENERGY ESTIMATION IN COLLISIONS OF VERY HIGH ENERGY PIONS WITH NUCLEI OF PHOTOGRAPHIC EMULSION [WYZNACZANIE ENERGII W ZDERZENIACH MEZONOW PI BARDZO WYSOKIEJ ENERGII Z JADRAMI EMULSJI FOTOGRAFICZNEJ]

J. Gierula and S. Krzywdzinski 1967 16 p refs Submitted for publication
(INR-828/VI/PH) CFSTI: $3.00

On the basis of about 500 interactions of particles with energy of few hundred GeV with nuclei of photographic emulsion, a systematic dependence of the median emission angle of secondary particles on the number of evaporation prongs has been found. In consequence, the corrections to the energy estimates calculated by the Castagnoli method have been obtained. Author

N68-11445 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

FRAGMENTATIONS OF COSMIC RAY NUCLEI WITHOUT PARTICLE PRODUCTION AT THE ENERGY RANGE 10–1000 GEV/NUCL. [FRAGMENCJE JADER PROMIENIOWANIA KOSMICZNEGO BEZ PRODUKCJI CZASTEK PRZY ENERGII OD 10–1000 GEV/NUKL]

Krzysztof Rybicki 1967 12 p refs Submitted for publication
(INR-792/VI/PH) CFSTI: $3.00

A total of 34 interactions in which primary nuclei of cosmic radiation break up without visible particle production are described. This process has been observed for $Z_{inc} = 2 \div 9$ nuclei at energies ranging from 10 GeV/nucl to some TeV/nucl. In majority of cases there are no tracks of low energy particles coming from target nucleus. These events are well interpreted in terms of photodisintegration of incident nucleus by photon from the Coulomb field of heavy emulsion nucleus /Ag, Br/. The remaining events correspond to collisions with light emulsion nuclei /H,C,N,O/ and are connected with strong interactions. Author

N68-11480# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

N–P CORRELATIONS IN LIGHT NUCLEI [NEITRON–PROTONNYE KORRELYATSII V LEGKIKH YADRAKH]

G. N. Afanas'ev 1967 24 p refs In RUSSIAN
(JINR-P4-3431)

The n–p correlations are treated by means of the Green functions method and generalized canonical transformations. It is shown that: the delay effects being taken into account do not change the nonsuperconductive character of the solution; the solutions with real (imaginary) correlation functions, identically different from zero, are energetically unfavorable; the following relation between phases of pp, nn, and np correlation functions should take place in general case: $\phi_{pp}+\phi_{nn}/2-\phi_{np}=0$; and in the case of charge symmetry (N=Z) the solution with identically vanishing np correlation function (for $\phi=0$) is completely equivalent to the solution with the equal in modulus pp, nn, and np correlation functions (for $\phi=\pi/2$). Author (NSA)

N68-11498# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

SOME MEASUREMENTS OF THE NEUTRON SCATTERING LAW FOR LIGHT WATER AT 95°C

Robert B. Smith Aug. 1967 47 p refs
(Contract AT(45-1)-1830)
(BNWL-345) CFSTI: HC$3.00/MF$0.65

Measurements were made of the double-differential scattering of slow neutrons from H_2O at 95°C using a triple-axis spectrometer. Scattering cross-section values were obtained by normalization to the measured scattering from vanadium and were further reduced to the Egelstaff scattering law presentation. With initial energy values from 100 to 377 MeV, results were obtained for neutron energy changes of 40 to 175 MeV and scattering angles of 4 to 70°. During the course of these measurements several sources of systematic errors in triple-axis spectrometer measurements were investigated. These include the effect of spatial nonuniformities in the neutron beam intensity and in analyzer sensitivity as well as multiple diffraction in beryllium monochromator crystals [simulated (0003) reflections were noted]. The magnitudes of these effects and methods of minimizing their contributions are discussed. Also described is a copper monochromator crystal in which mosaic was increased by mechanical deformation. Author (NSA)

N68-11500# Lyon Univ. (France).

STUDY OF THE REACTION $^{51}V(P,N)\ ^{51}CR$ AT LOW ENERGY [ETUDE D'UNE REACTION NUCLEAIRE A BASSE ENERGIE]

Gisele Espi (Ph.D. Thesis) May 1967 99 p refs In FRENCH
(LYCEN-6732)

The experimental curves of the excitation function of the neutrons emitted and the curve of their angular distribution as a function of the emission angle were studied in the reaction $^{51}V(p,n)\ ^{51}Cr$ for incident protons of 2 MeV maximum. At this energy it was predicted that the reaction would occur with formation of an intermediate compound nucleus of ^{51}Cr. Experiment verified this prediction. The neutron detection was made by time of flight by means of a plastic simulator associated with a time-amplitude analog converter permitting discrimination of the neutrons from γ parasites by time of flight. ^{51}V targets of three different thicknesses were used. For each target the excitation curve for the neutrons emitted in the reactions and their angular distribution were determined. The excitation curve of slowing variable form obtained with a total resolution of 60 keV could be used as a function of the statistical model. NSA

N68-11509# Texas Nuclear Corp., Austin.
[ON GAMMA-RAY PRODUCTION CROSS SECTIONS AND ANGULAR DISTRIBUTION MEASUREMENTS] Annual Progress Report
15 Aug. 1967 152 p
(Contract AT(40-1)-2791)
(ORO-2791-26) CFSTI: HC $3.00/MF $0.65

A description of the gamma-ray production cross sections and angular distribution measurements made during the year is given, and a summary of the present status of the overall cross section program at Texas Nuclear Corporation is included. Those elements studied during this reporting period included Mn, V, Fe, Nb, W, Pb, Na, Ce, Y, Bi, Sb, B, In, Co, Ta, Ag, Sc, Tl, Au, Cu, Al, Si, and A. The addition of a large-volume, coaxially drifted Ge(Li) detector to the spectrometer system is described along with details of the cross calibration of the Texas Nuclear Corp. long counter. Plans for interfacing the newly acquired 1600 channel analyzer with the IBM 1130 computer system are also presented. Theoretical studies based on the theories of Hauser–Feshbach and Satchler, suitably modified by appropriate width-fluctuation corrections, were continued and led to the assignment of nuclear level spins and parities. A discussion of the theoretical work in progress is given. Author (NSA)

N68-11514 Laboratoire de Physique Theorique de Des Hautes Energies, Orsay (France). Faculte des Sciences.
DYNAMICS OF STRONG INTERACTIONS
R. Onmes Oct. 1967 20 p refs Conf. held in Heidelberg
(TH-222)

The computation of strong interactions via a perturbation expansion is considered, and the observation is made that the phenomenology of strong interactions is dominated by Regge poles. Reggeization near t=0 is examined, with attention focused on the group theory method. The S-matrix approach to strong interactions is reviewed as a basis for discussing proposed bootstrap forms. These include the bootstrap of rising trajectories, and the preliminary results obtained for boson trajectories considered as baryon–anti-baryon bound states. M.G.J.

N68-11515 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
DIPS IN THE ω EXCHANGE CONTRIBUTION TO π N $\rightarrow$ ρ N
A. P. Contogouris, H. J. Lubatti, and J. Tran Thanh Van Oct. 1967 8 p refs
(TH-220)

Consideration is given to a specific combination of the differential cross sections for $\pi^+p \rightarrow \rho^+p(d\sigma_+/dt)$ and $\pi^-p \rightarrow \rho^0n(d\sigma_0/dt)$ which, at high energy, isolates the contribution of the ω-Regge trajectory. Usual reggeization rules and Mandelstam analyticity requirements predict that this combination should exhibit pronounced dips at $t\cong-0.5$ $(GeV/c)^2$ and $t\cong0$. Analysis of the existing data at pion incident lab. momentum $P_0=4$ and 8 GeV/c is found to support these predictions. Author

N68-11523# Istituto Nazionale di Fisica Nucleare, Padua (Italy).
ON THE SCATTERING OF NEUTRONS BY H_1^3 AND He_2^3 NUCLEI
L. Drigo, G. Moschini, and C. Villi 16 Feb. 1967 9 p refs
(INFN/BE-67/1)

Cross sections for neutron scattering by helium-3 and tritons and for the reaction $^3He(n,p)T$ are examined theoretically, with emphasis on conflicting experimental results in the published literature. Some of the critical aspects involved in present methods of analysis of unpolarized neutron data are discussed. NSA

N68-11528# Oak Ridge National Lab., Tenn.
STANDARDIZATION OF RADIO-NUCLIDES BASED ON DETERMINATIONS OF MASS
J. Klumpar [1967] 4 p Transl. into ENGLISH from Isotopenpraxis, v. 3, 1967 p 32–33
(ORNL-TR-1750) CFSTI: HC $3.00/MF $0.65

Calculation of the activity of radioisotopes from experimentally determined mass is discussed. By use of this method, the decay constant can be determined directly from the rate of decrease of activity. The advantage of the method proposed lies in the fact that in all cases it involves only a relative measurement, in which the type of radiation plays no part. NSA

N68-11530# Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany).
HIGH ENERGY PHYSICS INDEX, VOLUME 5, NUMBER 6 (2402-3072)
1967 243 p
(AED-C-23-14)

A bibliography is presented for literature received at DESY. This index covers experimental weak, electromagnetic, and strong interactions, strange particles, accelerators, methods, and instruments. Also theoretical weak, electromagnetic, and strong interactions, strange particles, symmetry principles, and field theory are covered. Author, report number, and subject indexes are included. NSA

N68-11532# California Univ., Berkeley. Dept. of Chemistry.
THEORETICAL STUDIES OF NUCLEAR STRUCTURE AND TRANSITIONS Progress Report, Year Ending Sep. 30, 1967
John O. Rasmussen and Gordon L. Struble Jul. 1967 54 p refs
(Contract AT(11-1)-34)
(UCB-34P141-8) CFSTI: HC $3.00/MF $0.65

An attempt was made to discover a relation between the energy and the spin of rotational states of deformed nuclei, and the accuracy of the quasi-boson method for calculating the seniority-one spectrum of a single-closed-shell spherical nucleus was studied. The seniority-one spectra of ^{89}Y and ^{90}Zr were calculated by direct diagonalization using a constant pairing force of adjustable strength, and the self-consistent description of nuclear structure was investigated. A quasiparticle model was formulated for odd–odd nuclei. Analyses of some spectroscopic experiments on the levels of ^{166}Ho, ^{140}La, and ^{142}Pr, in which (d,p), (n,γ), and (n,e$^-$) reactions were used, were performed. The problem of the Coriolis force for deformed nuclei was studied using the pairing plus quadrupole model. NSA

N68-11535 Wisconsin Univ., Madison. Theoretical Chemistry Inst.
COLLISIONAL TRANSFER CONTRIBUTIONS IN THE QUANTUM THEORY OF TRANSPORT PHENOMENA
Soesanto Imam-Rahajoe 7 Mar. 1967 201 p refs
(WIS-TCI-225)

The quantum mechanical BBGKY equations are solved in terms of the phase space transformation functions. Introducing the molecular chaos approximation, the pair distribution function is obtained. In the binary collision approximation this leads to a generalized Boltzmann equation, in which the collisional transfer contribution is included. This equation is solved by the method of Chapman and Enskog, and expressions for the transport properties are obtained. The classical limit ($\hbar \rightarrow 0$) of the expressions are also derived. The heat flux is found to contain a contribution which is proportional to the gradient of the density. The significance of this term, which is of the order $\hbar^4$, is discussed. Author

N68-11537# Los Alamos Scientific Lab., N. Mex.
A MODEL-BASED MASS LAW, AND THE R-PROCESS AS A MASS LAW TEST
Philip A. Seeger [1967] 32 p refs Presented at the 3rd Intern. Conf. on Atomic Masses, Winnipeg, Can.
(Contract W-7405-ENG-36)
(LA-DC-8950; CONF-670818-1) CFSTI: HC $3.00/MF $0.65

A mass law is presented, based on the liquid-drop model with shell and deformation corrections given by the Nilsson model and pairing energy by the Bardeen–Cooper–Schrieffer model. The resulting mass law has a total of 10 parameters, including all model parameters, and gives a standard deviation of 0.78 MeV when adjusted to the binding energies of 1127 known nuclei above mass 40. The r-process of nucleosynthesis is discussed and is shown to be relatively insensitive to all assumptions except the mass law. Results obtained using various mass laws are compared.
Author (NSA)

N68-11543# Naval Radiological Defense Lab., San Francisco, Calif.

FISSION PRODUCT DECAY CHAINS: SCHEMATICS WITH BRANCHING FRACTIONS, HALF-LIVES AND LITERATURE REFERENCES

Glenn R. Crocker 24 Jun. 1967 40 p refs
(Contract AT(49-7)-1963)
(USNRDL-TR-67-3; AD-659980)

Schematic diagrams of the decay chains for the fission products of uranium and plutonium are presented, with half-lives of the nuclides, branching fractions, and literature references. The updated data were obtained from a review of the literature through February 1967.
Author (TAB)

N68-11547# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.

THE LEVELS IN THE FOUR-NUCLEON SYSTEM [EUROVNI V SISTEME CHETYREKH NUKLONOV]

A. M. Badalyan, E. S. Gal'perin, V. N. Lyakhovskii, V. V. Pustovalov, Yu. A. Simonov et al 1967 48 p refs In RUSSIAN; ENGLISH summary
(NP-16946)

The four-nucleon wave-function is expanded for any spin and isotopic spin state as a series of K-harmonics—a complete set of harmonical angular functions in the nine-dimensional space. The Schroedinger equation then goes into a set of connected one-dimensional differential equations, which have the form of the two-particle Schroedinger equation. Keeping the lowest K for each spin–isospin state with a given angular momentum L one gets a single or two connected equations. The nineteen of these equations (the corresponding K=0, three K=1 and fifteen K=2) were solved numerically with two-nucleon potentials V_{13} and V_{31} of a square well, Yukawa and exponential form. The equation for K=0 (S=T=L=0) gives two bound states: the ground and the excited state 0^+ of ^{4}He. The equations for K=1 give no real states in this approximation, but are very close to being real. It is shown that the bound energy values obtained in this method are the upper limits, that is taking the highest harmonics into account may only increase the absolute value of the binding energy. The Coulomb correction to the binding energy of ^{4}He and the variations of binding energy due to uncertainties in the parameters of the two-nucleons potentials are calculated. The n^4 state is absent even if the potential depth is strongly increased. The striking dependence of the binding energy on the potential form allows in principle to fix this form; the two-, three-, and four-nucleon systems are solved simultaneously.
Author (NSA)

N68-11557 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEM ON SCATTERING OF A POINT MASS OF GAS AND ITS SOLUTION BY THE KINETIC THEORY [ZADACHA O RAZLETE TOCHECHNOY MASSY GAZA I EYE RESHENIYE PRI POMOSHCHI KINETICHESKOY TEORII]

V. P. Shidlovskiy *In its* J. of Appl. Mech. and Tech., Phys., No. 4, 1963 21 Apr. 1967 p 99–104 refs (See N68-11548 02-34)

An unsteady motion of a monatomic gas, corresponding to the escape of a point mass into vacuum, was studied by means of the kinetic theory of flows on the basis of the solution of the Boltzmann equation in the case of nonequilibrium initial distribution. Collisions among the molecules themselves were neglected. The more general case of escape in the presence of a potential power field invariable with time was also considered. It was found that the Boltzmann equation admits an exact solution with similar properties if the power field is constant in value and direction. A molecular model of solid, elastic, and smooth spheres was used for the study of both cases. It is concluded that the solution may be extended to the case of a mixture of monatomic gases.
Author

N68-11559 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF RADIAL DISTRIBUTION OF RADIATION PARAMETERS IN AN AXIALLY SYMMETRIC GASEOUS SUBSTANCE IN THE PRESENCE OF SELF-ABSORPTION [OPREDELENIYE RADIAL'NOGO RASPREDELENIYA PARAMETROV IZLUCHENIYA V OSESIMMETRICHNOM GAZOVOM OB'EKTE PRI NALICHII SAMOPOGLOSHCHENIYA]

A. V. Ivanov and M. M. Skotnikov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 113–118 refs (See N68-11548 02-34)

An analytic study was made to determine the radial distribution of radiation parameters in an axially symmetric gaseous medium with self-absorption. The problem consists of solving the energy transfer equation in integral form. First, the first order Volterra equation is approximated by N first order, linear algebraic equations, where N is the number of radiation zones into which the gaseous medium is divided, and in each of which constant average values are used for $\eta_\nu(r)$ and $B_\nu(r, T)$. Numerical computations are carried out for N=10. Then the gas is assumed optically thin (thickness less than 0.2) and the "ch" term (hyperbolic cosine) in equation (1) is assumed to be equal to unity. The resulting equation is analyzed as Abel's integral. Numerical results are given with absorption coefficient and radiative capacity of the gas varying from 0.2 to 0.9.
Author

N68-11577# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.

ON THE T-VIOLATION IN THE STRONG AND ELECTROMAGNETIC INTERACTIONS OF HADRONS [O NESOKHRANENII T-CHETNOSTI V SIL'NOM I ELEKTROMAGNITNOM VZAIMODEISTVIYAKH ADRONOV]

G. A. Lobov 1966 8 p refs In RUSSIAN; ENGLISH summary
(NP-16951)

The calculation of T-odd angular correlations at the cascade emission of two mixed γ-quanta by a polarized nucleus is fulfilled. The case of the arbitrary multipole structure has been considered. The polarization of the final nucleus was taken into account. The result is that number of the nuclei suitable for the experimental study of T-odd correlations is much increased.
Author (NSA)

N68-11578# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.

POSSIBILITY OF EXPERIMENTAL DETECTION OF THERMAL QUARKS [K VOPROSU O VOZMOZHNOSTI EKSPERIMENTAL'NOGO OBNARUZHENIYA TEPLOVYKH KVARKOV]

Yu. A. Kucheryaev 1967 53 p refs In RUSSIAN
(IAE-1285)

The quark model assumes the existence of three particles (p, n and λ-quarks) with electric charges respectively of +2/3, −1/3 and −1/3 of an elementary electric charge. The quark mass is unknown but should be >7 GeV. Estimates of the concentration of thermal quarks lead to values of 10^{-9} to 10^{-10} quarks

per nucleon. Methods of searching for thermal quarks include a mass-spectrometric method and Milliken's oil drop method where the charge is measured directly. Another possible method of detecting thermal quarks, which is discussed in detail involves the collection of quark ions on a metal surface. Since the charge of a quark ion is less than one, its binding energy with the metal surface can be significantly less than the binding energy of an ordinary, single-charged ion. Since the time of accumulation of quark ions on the electrode surface can be many orders of magnitude greater than the time of desorption, the method is inherently more sensitive than the other methods. All the discussions consider only quark ions with a charge of $-1/3$. A possible experimental arrangement for detecting quark ions is given. NSA

N68-11579# Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany).
HIGH ENERGY PHYSICS INDEX, VOLUME 5, NUMBER 7 (3073-3767)
1967 177 p
(AED-C-23-15)

A bibliography is presented for literature received at DESY. This index covers experimental information on weak, electromagnetic, and strong interactions, strange particles, accelerations, methods, and instruments. Also theoretical information on weak, electromagnetic, and strong interactions, strange particles, symmetry principles, and field theory are covered. Author, report number, and subject indexes are included. NSA

N68-11592# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
RADIATIVE CORRECTIONS TO VECTOR β-DECAYS [CORREZIONI RADIATIVE AI DECADIMENTI β]
L. Maiani 12 Sep. 1967 17 p refs Presented at Heidelberg Intern. Conf. on Elementary Particles, 18–27 Sep. 1967
(ISS-67/29) CFSTI: HC $3.00/MF $0.65

Recent developments in the field of radiative corrections to β-decays are reviewed. These include the attempts to make the corrections finite through a suitable modification of the quark current algebra, as well as the consequences of the existence of the intermediate boson. Author

N68-11600# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
ON THE DIRECT EXCITATION OF THE FISSION OF NUCLEI AT LOW ENERGIES [O PRYAMOM VOZBUZHDENII DELITEL'NYKH STEPENEI SVOBODY YADRA PRI NIZKIKH ENERGIYAKH]
P. E. Vorotnikov 1966 16 p refs In RUSSIAN
(IAE-1179)

The direct excitation of the fission of nuclei at low energies was calculated. The calculations showed the important effect of surface excitation as a result of the direct interaction of incident particles with the collective order of free nuclei in fission processes. The dividing width for nuclei with asymmetric deformation is at least two powers higher than for symmetrically deformed nuclei. The fission of symmetrically deformed nuclei occurs after its transition by asymmetric excitation. In such transitions the energy expended is ≈ 1 MeV. Exchange with excitation between collective and monoparticle orders of the free nuclei is a comparatively slow process. The fission at $E^* \approx 6$ MeV remains below the barrier, and the permeability of the potential fission barrier $\approx 10^{-6}$. The height of the potential barrier is at least 2 MeV higher than that assumed previously. Author (NSA)

N68-11608 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ENERGY SPECTRUM OF ALPHA PARTICLES FROM THE ^{122}Te(n,α) ^{119}Sn AND ^{169}Tm(n,α) ^{166}Ho REACTIONS WITH 14.2 MeV NEUTRONS [ROZKLADY ENERGETYCZNE CZASTEK ALFA Z REAKCJI ^{122}Te(n,α) ^{119}Sn I ^{169}Tm(n,α) ^{166}Ho PRZY ENERGII NEUTRONOW 14.2 MeV]
N. Jaskola, W. Osakiewicz, J. Turkiewicz, and Z. Wilhelmi [1967] 16 p refs
(INR-814/I/PL) CFSTI: $3.00

The energy spectrum of alpha particles from the ^{122}Te(n,α) ^{119}Sn and ^{169}Tm(n,α) ^{166}Ho reactions at 14.2 MeV has been studied using the semiconductor detector technique. The analysis of the energy spectrum leads to results that the evaporation theory is inadequate to the description of the investigated reactions. The shapes of the experimental spectra suggest the presence of strong direct effects in the investigated reactions. Author

N68-11614# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
CROSS SECTION OF INTERACTION OF 710-MEV DEUTERONS WITH ^{27}AL NUCLEI [SECHENIYA VZAIMODEISTVIYA DEITRONOV ENERGII 710 MEV S YADRAMI ^{27}AL]
V. S. Borisov, G. K. Bysheva, L. L. Gol'din, L. N. Kondrat'ev, Z. S. Sidorenko et al 1966 8 p refs In RUSSIAN
(ITEF-478)

The cross sections of the interactions of deuterons with aluminium at 710 MeV are presented. The data are discussed in terms of the optical model for a complex particle, assuming the nucleus to be absolutely black. Author (NSA)

N68-11615# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
INELASTIC SCATTERING OF A PROTON ON A DEUTERON [NEUPRUGOE RASSEYANIE PROTONA NA DEITRONE]
E. I. Dubovoi 1967 16 p refs In RUSSIAN
(ITEF-501)

A theoretical interpretation of some previously unreported experimental results for the reaction D(p,n)2p at 9 MeV is given; and, on the basis of qualitative properties of the differential cross section as a function of kinematical variables, the reaction mechanism is identified. Author (NSA)

N68-11634*# Research Systems, Inc., Lexington, Mass.
A STUDY OF TRACE CONTAMINANT IDENTIFICATION BY MICROWAVE DOUBLE RESONANCE SPECTROSCOPY
Richard J. Volpicelli, Otto L. Stiefvater, and George W. Flynn Washington NASA Dec. 1967 99 p refs
(Contract NAS1-6308)
(NASA-CR-967) CFSTI: $3.00 CSCL 07D

A microwave double resonance spectrometer has been assembled that operates with pump frequencies between 12 GHz and 18 GHz and signal frequencies between 26.5 GHz and 40 GHz. The absorption cell consists of a coiled 100 ft section of X-band guide. Modulation of the double resonance phenomenon is achieved through frequency modulation of the pump radiation, the modulation frequency being 100 KHz. For each of the five molecules ($CH_3CH_2COH_1$) $CH_3CH_2CH_2Cl$, CH_3CH_2COOH, $(CH_3)_2S$, and CH_2Cl_2, one or two double resonance connections were selected and suitable for the identification of these compounds. The amplitude of the double resonance signals was studied as a function of the sample pressure for both pure samples and samples diluted in air. In typical cases double resonance signals could be observed in the pressure range from 1 μHg to $\approx$ 100 μHg. The smallest detectable amount of a gas contaminant was of the order

of ≈ .3%. In mixtures of several gases with rich microwave spectra the double resonance technique affords a rapid and extremely specific method for identifying individual components, and there is no ambiguity due to interference from neighboring and/or overlapping lines with only one double resonance connection required to identify the compound from which it arises. Author

N68-11696# California Inst. of Tech., Pasadena.
GAMMA-RAY CALIBRATION ENERGIES
Jerry B. Marion Jan. 1967 43 p refs
(Contract Nonr-220(47))
(AD-660419)

A tabulation is given of gamma-ray energies which are suitable for calibrating high-resolution gamma-ray spectrometers. Data from studies of both radioactive sources and nuclear reactions are included, allowing precision calibration in the range 60 keV < E-gamma < 9 MeV. Author (TAB)

N68-11707# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
EFFECTS OF THE S-STATE PION–NUCLEON INTERACTION ON THE PARTIAL-WAVE NUCLEON–NUCLEON ABSORPTIONS [EFFETTI DELL'INTERAZIONE PION–NUCLEONE IN ONDA S SUGLI ASSORBIMENTI NELL'URTO NUCLEON–NUCLEONE]
S. Francaviglia 8 Sep. 1967 17 p refs
(ISS-67/25) CFSTI: HC $3.00

The absorptions in proton–proton scattering around 1 GeV of laboratory kinetic energy of incident proton are computed. A previous calculation is extended by taking into account, besides the production of the resonance I=3/2, J=3/2(P_{33}), the production of pions in S_{11} and S_{31} state in respect to one nucleon as inelastic process. These waves are the most important in the hypothesis of P_{33} dominance in the scattering. The $^3P_0$ and $^3P_1$ absorptions are found to violate the unitarity limits while the other waves are almost unaffected. Author

N68-11718 Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
FURTHER RESULTS OF THE MONTE CARLO CALCULATION OF THE (E,E'P) REACTION FOR INCIDENT ENERGIES BETWEEN 300 AND 600 MEV [ULTERIORI RISULTATI DI UN CALCOLO, BASATO SUL METODO DI MONTECARLO, RELATIVI ALLA REAZIONE (E,E'P)]
G. Farchi 22 Mar. 1967 47 p
(ISS-67/9) CFSTI: HC $3.00

This paper completes the results of the report ISS 66/37, "Some Results of the Montecarlo Calculation of the (e,e'p) Reaction for Incident Energies between 300 and 600 MeV", adding the values valid for a s-state with 70 MeV proton binding energy. Electron scattering angles and incident energies are kept the same as ISS 66/37. Ejected proton kinetic energies are still between 40 and 100 MeV. Author

N68-11777 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
CURRENT ALGEBRA AND K^+-K^0 MASS DIFFERENCE
F. Capra Oct. 1967 11 p refs
(TH-221)

Using the spectron sum rules of Weinberg and the soft meson technique, we calculate the electromagnetic mass splitting of the kaons. We show that the essential contribution comes from "σ-terms" which can be evaluated with the help of the σ model and of the tadpole theory of Coleman and Glashow. Our result depends on the unknown mass of the scalar isoscalar meson σ_8. Identification of the resonance ϵ (700) with this meson gives a mass difference of $\delta\, m_K = -3.55 \pm 2.71$ MeV in good agreement with experiment. Author

N68-11796 Tokyo Univ. of Education (Japan). Dept. of Physics.
MASSES OF BOSONS WITH SPIN ONE UNIT AND THE ALGEBRA OF FIELDS
Syurei Iwao [1967] 6 p refs

Recently Weinberg's sum rules on the spectral functions have been applied to the mass eigenvalues of vector and axial vector mesons. The Lagrangian assumed is this treatment is based on the one proposed in the theory of field current identities and the algebra of fields. A purpose of this letter is to study the theoretical parameters appearing in this theory by assuming (1) that Lagrangian density and (2) the pure U(3) symmetry without referring to the Weinberg's sum rules. Interpreting the parameters appearing in the theory, it was found that the mass squares of the axial vector nonet were approximately twice as large as the corresponding mass squares for the vector nonet. A consistency with the Weinberg's sum rule was re-examined at this stage. Author

N68-11814# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
PROGRESS REPORT, JULY 1, 1967 TO SEPTEMBER 30, 1967
30 Sep. 1967 83 p refs
(PR-P-75; AECL-2780) Available from Atomic Energy of Canada, Ltd., Chalk River: $2.00

Nuclear physics and solid state research equipment performance is summarized and progress assessments for various studies in nuclear, general, neutron, and theoretical physics are presented. E.C.

N68-11818 Laboratoire de Physique Theorique et des Hautes Energies, Nice (France). Faculte des Sciences.
CRITICAL SCATTERING OF ELECTRONS BY POLAR MOLECULES
Jean-Marc Levy-Leblond and Jean-Pierre Provost [1967] 7 p refs

A theoretical analysis is given of slow electrons scattering by polar molecules with nearly critical dipole moments. Author

N68-11820# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE $J^P = 1+$ OCTODECIMET OF MESON RESONANCES [L'OTTODECIMETTO DELLE RISONANZE MESONICHE CON $J^P = 1+$]
R. Gatto and L. Maiani 26 Oct. 1967 18 p refs
(ISS-67/36) CFSTI: HC $3.00/MF $0.65

A discussion is presented of an SU_3 complex (called "octodecimet") arising naturally in the quark picture of boson resonances, and constituted of two mixed nonets with same spin and parity, and opposite charge conjugation. Mass formulae for the general case are discussed. We consider further the possibility that axial vector mesons group into an octodecimet, and discuss the possible assignments. Also their decays into vector and pseudoscalar mesons are considered, and experimental data are compared with the predictions of the octodecimet model. Even though very firm conclusions cannot be reached, due to experimental uncertainties, the picture appears to be quite consistent. Some predictions of the model for the production of the mixed strange members of the axial octodecimet are briefly exposed. Author

N68-11853*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CALCULATED SPECTRUM OF INVERSE COMPTON SCATTERED PHOTONS
Frank C. Jones Nov. 1967 51 p refs Revised
(NASA-TM-X-55604; X-641-68-379) CFSTI: HC $3.00/MF $0.65
CSCL 20H

We consider an electron of a given energy moving in a mono-energetic, isotropic radiation field. The energy spectrum of the photons that are scattered by the electron has been calculated

both exactly and in a greatly simplified approximate form suitable for astrophysical calculations. The approximation may be derived either by expanding the exact solution in a small parameter and keeping only the leading terms or by employing a simplifying physical approximation at the beginning of the calculation. The approximate spectrum is similar to one previously derived by Ginzburg and Syrovatskii, the principal difference being that the present one does not break down if $h\omega_1 E > (m_e c^2)^2$ where $h\omega_1$ is the initial photon energy and E the electron energy. We indicate the astrophysical applications of our approximate spectrum by calculating the spectrum of photons scattered by electrons with an inverse-power-law energy distribution. Author

N68-11880 Technische Hochschule Munchen (West Germany).
MICROSCOPIC CALCULATION OF ALL T^3 CONTRIBUTIONS TO THE SPECIFIC HEAT OF A NORMAL FERMI LIQUID [MIKROSKOPISCHE BERECHNUNG ALLER T^3-BEITRAEGE ZUR SPEZIFISCHEN WAERME EINER NORMALEN FERMI-FLUESSIGKEIT]
Eberhard Riedel (Ph.D. Thesis) [1966] 44 p refs In GERMAN
CFSTI: $3.00

The large thermodynamic potential of a normal Fermi fluid is represented by potential approximation method as a parameter of two and four dimensional functions. A low temperature development is used for calculating the effects of Fermi and Bose type excitations on the system as well as the alternating effects on the thermodynamic properties of the Fermi fluid at low temperatures. A microscopic Landau model calculation follows specific heat in the Fermi fluid up to the second order of the low temperature reaction. Additional values are obtained for a softening Fermi sphere, the reciprocal effect of single particle excitation, and the collective stimulation of the system. It is shown that single particle damping and collective excitation do not affect temperature development up to the second power. Transl. by G.G.

N68-11888* Maryland Univ., College Park. Dept. of Physics and Astronomy.
ON THE NUCLEON AXIAL VECTOR FORM FACTOR
Victor Kien-chung Yu Sep. 1967 58 p refs
(Grants NsG-398; NSF GP-6036)
(TR-736) CSCL 20H

It has been shown by Woo in a derivation of the nucleon axial vector form factor, using the multi-channel N/D method, approximating the I=1, J=1, parity +, 3π intermediate state, that this gives insufficient contribution to explain the momentum transfer dependence of the form factor. Contributions from scalar mesons are studied. Various schemes suggesting scalar mesons have been considered. Some of the parameters proposed are applied; i.e., a narrow width 500 MeV scalar meson and a 700 MeV scalar meson with relatively large width. It is shown that the inclusion of the pion scalar dipion intermediate states will improve agreement with experiment. Author

N68-11898 Technische Hochschule Munchen (West Germany).
ELASTIC AND LOW-ENERGY INELASTIC SCATTERING OF THERMAL AND SUBTHERMAL NEUTRONS [ELASTISCHE UND NIEDERENERGETISCH-INELASTISCHE STREUUNG THERMISCHER UND SUBTHERMISCHER NEUTRONEN]
Wolfgang Mehringer (Ph.D. Thesis) [1967] 61 p refs In GERMAN
CFSTI: $3.00

Elastic and low-energy inelastic single and multiple scattering processes of thermal and subthermal neutrons in solid systems were analyzed for the geometric-optical effects of the solid body on the interference patterns. Determined were neutron scattering processes in long wave phonons with density variations, in quantitatized acoustic waves, in incoherent nucleus spin, and in coherent elastic nucleus spin. Interference elimination and intensity shifts with a disturbed interference pattern were only obtained when a broad thermal spectrum was used; sharper focusing of the spectrographic slit always resulted in clear interference patterns. Transl. by G.G.

N68-11903*# New York Univ., N. Y.
QUANTUM MECHANICAL STUDY OF MOLECULES: EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC MATRICES
G. R. Verma, C. D. La Budde, and R. C. Sahni Washington NASA Dec. 1967 48 p refs
(Grant NsG-76)
(NASA-CR-983) CFSTI: HC $3.00/MF $0.65 CSCL 20J

In this report, three general classes of methods for calculating the eigenvalues and eigenvectors of real symmetric matrices arising in quantum mechanical calculations are described: the Sturm sequence methods, the orthogonal reduction methods, and the step by step methods. The advantages and limitations of each method are pointed out. The report also includes the discussion of various methods of reducing real symmetric matrices to more compact convenient forms. Methods of reduction to tridiagonal form, and deflation of matrices to smaller order are described. Author

N68-11904# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
APPLICATIONS OF MOLECULAR BEAMS TO THE MEASUREMENT OF COLLISION CROSS SECTIONS AND TO THE DETERMINATION OF INTERMOLECULAR FORCES
I. Amdur Jul. 1967 23 p refs Presented at First Intern. Symp. on Mol. Beams of High Energy, Cannes, Jul. 1967
(Contract N00014-67-A-0204-004)
(TR-2(18); AD-660042)

The experimental basis for the determination of intermolecular forces from the scattering of high velocity neutral beams is discussed with special reference to the following: Conditions which must prevail if classical mechanics is to be used in the analysis of the scattering results; the role of apparatus geometry with respect to the changes of interaction distances in which potentials derived from scattering will be valid; the type of apparatus which is suitable for obtaining repulsive potentials in the approximate range 0.1-10 eV. Typical results are given to illustrate the general features of the scattering of neutral beams of this type. The most important of these features are the strong forward scattering, the dependence of experimental total cross sections on apparatus geometry, and the magnitudes and ranges of validity of the derived interaction potentials. It is shown that the potential energy information obtained from the scattering experiments may be successfully applied to a variety of problems among which are high temperature transport properties of gases and properties of alkali halides in the solid and gaseous state. Author (TAB)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-11046*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
KINETIC EQUATION FOR A PLASMA AND ITS APPLICATION TO HIGH FREQUENCY CONDUCTIVITY
Jerry H. M. Fu, R. L. Guernsey, and R. S. B. Ong Apr. 1967 101 p refs
(Grants NsG-220-62; AF-AFOSR-825-65; AF-AFOSR-825-67)
(NASA-CR-90296; AFOSR-67-1888; AD-657362) CSCL 20I

A kinetic equation for an inhomogeneous and nonisotropic plasma is derived in the plasma limit. The treatment is based on

the joint solution of the first two members of the BBKGY hierarchy, and on a linearization procedure about the unperturbed state. The unperturbed distribution functions are unspecified. Furthermore, the unperturbed pair correlation function is eliminated in favor of the unperturbed one-particle distribution function. The resulting kinetic equation is free from Bogolyubov's adiabatic hypothesis; therefore, it is valid for arbitrary frequency. In the limiting case when the frequency under consideration is much higher than the collision-frequency, a general expression for the high-frequency electric conductivity tensor is derived. From this general expression the results for the homogeneous and isotropic case previously derived by Klevans and Wu, as well as the results for the thermodynamic eqilibrium case derived by Oberman, Ron, and Dawson can be recovered. Author (TAB)

N68-11059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ON THE UTILITY OF CONVENTIONAL TURBULENCE EXPERIMENTAL METHODS IN THE STUDY OF PLASMA FLUCTUATIONS

John S. Serafini Washington 1967 21 p refs Presented at the 20th Anniv. Meeting of the Fluid Dyn. Div. of the Am. Phys. Soc., Bethlehem, Pa., 20–22 Nov. 1967

(NASA-TM-X-52371) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experimental methods common in studies of ordinary fluid-dynamic turbulence are found to have significant application in the studies of plasma fluctuations. The low-frequency fluctuations, believed to have connection with problems of anomalous diffusion, are easily measured with presently available turbulence-measuring equipment. In particular, the space–time correlations of plasma fluctuations are useful in revealing convective effects. The rejection of various portions of the frequency spectra of the signals prior to their being correlated allows a further insight into the relationships between low-frequency peak portion and the remaining spectral portion of the fluctuations. The techniques and their application are discussed for the case of an annular Hall-current plasma accelerator. A slightly ionized argon discharge is subjected to an axial electric field and a radial magnetic field. The fluctuations are measured using Langmuir probes. In addition to the r.m.s. magnitude and amplitude spectra, the space–time correlations of the fluctuations have been made with a correlation analyzer having a response up to 500 khz. The results are compared with those obtained in fluid-dynamic turbulence studies. Author

N68-11083*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECT OF AXIAL FLOW ON THE BEHAVIOR OF THE WALL-CONSTRICTED ARC

Howard A. Stine, Velvin R. Watson, and Charles E. Shepard 1964 43 p refs Presented at the AGARD Specialists' Meeting on Arc Heaters and MHD Accelerators for Aerodyn. Purposes, Rhode-Saint-Genese (Belgium), 21–23 Sep. 1964

(NASA-TM-X-54065) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An experimental and theoretical study of the interaction between an electric arc and a coaxial flow of gas has been carried out in a range of size, enthalpy level, and pressure level where radiation heat loss is a noticeable portion of the total loss from the system. Numerical calculations have been performed and have been compared with earlier analytic calculations and also with the experimental results. Although differences in the detailed behavior of the gas flow-arc interaction are predicted by the two theoretical methods, the integrated behavior as deduced by either of the theoretical methods is essentially the same. Moreover, this integrated behavior is in substantial agreement with the experimental results, at least insofar as predictions of buildup of energy flux is concerned. Author

N68-11093# Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies.

APPLICATION OF THE COLLECTIVE APPROACH TO THE THERMODYNAMICS OF AN ELECTRON GAS

Richard L. Liboff and Lawrence J. Caroff Sep. 1967 95 p refs Supported in part by Hughes Aircraft Corp.

(Contract Nonr-401(60))

(LPS-1; AD-660424)

The collective approach of Pines and Bohm was applied to the problem of the thermodynamics of the N-particle electron gas including transverse radiation. Partitioning of the internal energy and certain of the other thermodynamic quantities is discussed generally. The system is seen to divide itself into three approximately independent subsystems: (1) an infinite set of free harmonic oscillators, corresponding to the transverse field; (2) a set of s free harmonic oscillators corresponding to the longitudinal (plasma) oscillations, with an energy spectrum h-bar omega sub T (k), given by the dispersion relation for plasma oscillations; and (3) a set of (N - s/3) quasi-particles of mass approximately equal to the electron mass, interacting via . short-range potential which is essentially screened Coulomb. Analytical expressions for the energy, pressure, and constant-volume specific heat of the transverse oscillators are given, together with approximate expressions applicable to the high-density-low-temperature and low-density-high-temperature limits. Detailed numerical calculations of the internal energy and pressure of the longitudinal modes are presented. Author (TAB)

N68-11139 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.

HIGH TEMPERATURE ENERGY SYSTEMS WITH PLASMA REACTORS AND INDUCTIVE MAGNETOPLASMADYNAMIC CONVERTERS [HOCHTEMPERATUR-ENERGIESYSTEME UNTER VERWENDUNG VON PLASMAREAKTOREN UND INDUKTIVEN MAGNETOPLASMADYNAMISCHEN WANDLERN]

W. Peschka Sep. 1967 25 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-59) CFSTI: $3.00

The purpose of this paper is to investigate possible future power generating equipment which operates with high temperature plasma as a working medium and subsequently with high power density. This temperature range requires reactors whose nuclear fuel is in the plasma (fission or fusion reactors) coupled to magnetoplasmadynamic generators acting as energy converters. Electrodeless MPD-Generators with all their advantages can be successfully employed. The technological ramifications arising from the application of these high temperatures with respect to the reactors and the MPD-Generators as well as to the heat release equipment are discussed. Author

N68-11155 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

INVESTIGATION OF FAST-ACTING ELECTROMAGNETIC GAS-INLET VALVES [UNTERSUCHUNGEN AN SCHNELL OEFFNENDEN ELEKTROMAGNETISCHEN GASEINLASSVENTILEN]

H. Brinkschulte, H. Finkelmeyer, G. Hofmann, W. Makios, H. Muntenbruch et al Jul. 1967 36 p refs In GERMAN; ENGLISH summary

(IPP-1/68; IPP-3/56) CFSTI: $3.00

For some plasma physics experiments it is necessary to admit a definite quantity of gas into a discharge vessel during a very short time interval. For such applications some slightly different valves were built and their operating characteristics were tested. The valves, of metallic construction, are operated using the magnetic fields produced by coils. The operation of the valves was examined with a photomultiplier and a 4 mm microwave apparatus. By measuring the pressure increase, the total number of particles admitted was determined as a function of the valve parameters. The behaviour of the gas as it streams into the vacuum vessel was investigated with a Mach–Zehnder interferometer, a piezo-electric probe, and an ionization gauge. Comparison of the measured and

calculated values gave good agreement between experiment and theory, and enables one to recognize the main characteristics of such valves. Author

N68-11156 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Plasmadynamik.
MICROWAVE-INTERFEROMETRY IN ARGON LOW PRESSURE DISCHARGES [MIKROWELLENINTERFEROMETRIE AN ARGONNIEDERDRUCKENTLADUNGEN]
F. Kuenstler and D. Goll Sep. 1967 45 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-62)

The electron density as well as the medium electron collision frequency of an argon low pressure plasma at a pressure range between 0.5 to 5 Torr is determined in the microwave region by using the dispersion law. The argon discharge contains in addition mercury with partial pressure of approximately 10^{-2} Torr. The calculated conductivity from the electron density and electron collision frequency will be compared with the conductivity from a current and voltage measurement. Further is given the radial distribution of the electron density of a cylindrical argon low pressure discharge by using the Abel transformation. The width of the bundled microwave ray is smaller than the diameter of the low pressure discharge. If the assumption is not fulfilled that the diameter of the discharge is greater than the diameter of the microwave ray, so another method is possible which gives also usable results under certain conditions. Author

N68-11157 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
SELF-ABSORPTION RESONANCES AT THE ELECTRON-CYCLOTRON HARMONICS
G. Landauer Sep. 1966 18 p refs
(IPP-3/60)

Sharp self-absorption resonances at the electron-cyclotron harmonics ($n \approx 4$–18) appear in radiation spectra, when the PIG discharge is superimposed by a secondary plasma. This plasma is established by two electrodes which produce a static electric field E||B. The radiation level ("background"), in which at a frequency $f \approx 10$ GHz the self-absorption resonances could be observed, is rather high. On the contrary, normal cyclotron-harmonic emission spectra of the PIG discharge have low background radiation. Author

N68-11172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECTROSCOPIC INVESTIGATION OF A HIGH CURRENT DISCHARGE IN THE AIR AT LOW DENSITIES [SPEKTROSKOPICHESKIYE ISSLEDOVANIYA SIL'NOTOCHNOGO RAZRYADA V VOZDUKHE PRI NIZKIKH PLOTNOSTYAKH]
L. S. Nikolayevskiy, A. F. Simonenko, and S. G. Grenishin 14 Jun. 1967 17 p refs Transl. into English from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR, v. 4, no. 6, 1966 p 485–490
(FTD-HT-66-650; TT-67-63234; AD-660397)

The spectroscopic method was used to investigate an air plasma at 35,000K, activated at different initial temperatures, in a discharge tube specially constructed for the purpose. In addition to the temperature, determinations were made of the concentration of the charged particles, the presence of thermodynamic equilibrium was established, and the emissivity of the air was measured. The article gives a diagram of the tube. The integral spectra with time in the region of 3000 to 7000A were taken with a spectrophotometer with a diffraction grid with a reverse linear dispersion of 5A/mm, and a type ISP-28 quartz spectrograph. The concentration of ne electrons was determined from the width of the H-beta hydrogen line. The temperature of the plasma was determined from the ratio of the intensities of the OII lines. A table shows the experimental values of the concentration of the components of an air plasma as a function of the initial pressure. Further data are presented to establish that the plasma is in a state of thermodynamic equilibrium. Author (TAB)

N68-11183# Sandia Corp., Albuquerque, N. Mex.
MULTIFLUID THEORY FOR THE STAGNATION FLOW OF A PREIONIZED GAS
D. H. Johnson and K. J. Touryan Jul. 1967 39 p refs
(SC-RR-67-289) CFSTI: HC $3.00/MF $0.65

Governing equations and boundary conditions are developed for the stagnation flow of a partially ionized monatomic plasma over a biased body using the multifluid theory. The transport properties and collision integrals for the various plasma species are discussed in detail. In practice, the flow of a supersonic preionized gas over a blunt body has applications in the areas of arc jet diagnostics and evaluation of arc jets as simulation devices for materials testing. Author

N68-11221# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INFLUENCE OF CONVECTION ON CURRENT PATTERNS IN NONEQUILIBRIUM PLASMAS
Arthur Sherman and Hsuan Yeh Oct. 1967 46 p refs
(R67SD61; AD-660123)

The phenomenon of convection is investigated in nonequilibrium plasmas where there are substantial nonuniformities in the plasma state. It is shown that one can formulate a boundary value problem to solve for the current stream function and the electron temperature including convective effects. The resulting equations are coupled and nonlinear so they are solved by an iteration technique. Two simple examples are chosen to illustrate the procedure. The first consists of a pair of electrodes in a straight channel, and the second is the entrance region of a parallel walled solid electrode device. In each case, only an applied electric field was considered. The calculations show the current streamlines and the electron temperature distribution displaced downstream for both uniform and nonuniform flows. It is also shown that as the flow velocity increases the voltage necessary to pass a specified amount of current increases. Author (TAB)

N68-11227# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
RADAR SCATTERING FROM A PLANE PARALLEL TURBULENT PLASMA SLAB WITH STEP FUNCTION FLUCTUATIONS OF ELECTRON DENSITY
Adolf R. Hochstim and Charles P. Martens Sep. 1967 16 p refs
(Contract DAHC15-67-C-0011)
(IDA/HQ-67-6376; P-316; AD-659998)

A deterministic method of calculating radar propagation through a turbulent plasma is developed which involves the exact solution to the wave propagation equation through a slab in which the dielectric constant can vary randomly, repeated for an ensemble of slabs having common, prescribed statistical properties. The method is applied to the case of a plant wave normally incident upon an infinite plane parallel slab which, when unperturbed, is homogeneous. The electron density is perturbed by step function fluctuations which alternately increase or decrease the mean density by an equal amount. The lengths of the step function fluctuations have an exponential probability density. It is found that for the cases studied (underdense plasma) an ensemble of approximately 600 profiles is required in order to obtain meaningful averages. The mean reflection coefficients are compared with results obtained using the first order Born approximation, and the agreement is satisfactory in those cases for which the Born approximation is expected to be valid. The most significant departures from the Born approximation occur for low values of collision frequency/angular frequency of incident radiation and for high values of the root mean square electron density fluctuations. The reflection coefficient in the Born approximation is also derived for a general distribution

of step function fluctuation lengths in a slab of finite thickness, and relaxation times are reviewed for the wakes of reentry vehicles.
Author (TAB)

N68-11231 National Aerospace Lab., Tokyo (Japan).
DRIVING MECHANISM OF AN ELECTRIC SHOCK TUBE WITH A COAXIAL GUN
Ri'ichi Matsuzaki 1967 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-135)

The flow in an electric shock tube was investigated by using phototransistors: it was observed that the flow consisted of a strongly luminous, thin layer and a less luminous succeeding region. Electron density in the succeeding region was measured by microwave interferometry to be of the order of $0.45\times10^{12}/cm^3$ at a discharge energy of 0.3 kJ. Measurement with phototransistors also revealed the successive position of the luminous front as a function of time; velocity diagram of the front was derived from this and showed a maximum velocity at a point along the tube wall. In order to verify the presence of the maximum value and then to investigate the driving mechanism of the electric shock tube, a theoretical study was performed which was based on the conception of the snow plow model. In this approach, particularly, the driving force was assumed to be due to the magnetic pressure generated by the discharge current in the coaxial driver gun. The experimental results agreed very well with the snow plow calculation.
Author

N68-11353* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A METHOD OF OBTAINING SOME EXACT (NONLINEAR) SOLUTIONS OF THE BOLTZMANN–VLASOV EQUATIONS
Robert N. Seitz 28 Aug. 1962 76 p refs
(NASA-TM-X-60607) CSCL 20I

This paper describes a method for obtaining the exact, nonlinear, steady-state solutions of the "collisionless" Boltzmann–Vlasov equations for cylindrical and spherical diodes. It is shown that, when the electron and ion distribution functions along the boundaries of such a diode are functions only of known constants of the motion, the distribution function at all interior points can be prescribed as a functional of the electromagnetic momenta and the electromagnetic potentials ϕ and A. If, in addition, all of the first integrals of the motion can be specified, as is the case when cylindrical or spherical symmetry is present, then it is shown that the Poisson equation may be reduced to quadratures. Finally, the method is applied to the problem of ion beam neutralization and numerical results are given. Among the other applications of the integral-of-the-motion method developed herein is the solution of the long-standing problem of the potential distribution across a cylindrical thermionic diode with thermal effects rigorously taken into account.
Author

N68-11386# Washington Univ., Seattle. Dept. of Electrical Engineering.
TRANSIENT WAVE PROPAGATION IN A PLASMA
B. L. Jaganmohana Rao and Akira Ishimaru May 1967 42 p refs
(Contract AF 19(628)-5879)
(AFCRL-67-0383; SR-2; TR-116; AD-659758)

The transient fields due to a dipole placed in lossless plasma and excited by a delta function or a step-modulated sine wave current source were obtained in closed form. Far field approximation was used in the case of step-modulated sine wave. An interesting problem of transmission and reflection of a step-modulated sinusoidal plane wave, when it is incident normally at the boundary of a semi-infinite plasma or a plasma slab was also included.
Author (TAB)

N68-11400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF GAS DYNAMIC FACTORS IN THE CALCULATION OF ELECTRIC ARC HEATERS WITH VORTEX GAS STABILIZATION OF AN ARC
B. D. Voronin, A. M. Tsirlin, and M. Ya. Smelyanskiy 9 Jun. 1967 16 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 10, no. 3, 1966 p 287–293
(FTD-MT-67-38; TT-67-63129; AD-659912)

Experiments were carried out on stabilization of an arc by a vortex gas flow in an electric hydrogen heater. Boundaries of stable operation of the apparatus were found. Investigations of gas dynamics reveal an explicit similarity between the dependence of the limiting current and the tangential velocity in the electrode channel on the gas flow rate. The quantitative relation was found experimentally between the controlling parameters of the heater to express the gas-dynamic conditions of the arc stabilization at the boundary of the steady operation region. Many equations are presented for the calculation of electrical parameters and characteristic dimensions (the anode diameter) which provide a good stabilization of the arc and the required heat generation for a particular type of electrical heater.
TAB

N68-11404*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER TRANSFER TO ION CYCLOTRON WAVES IN A TWO ION SPECIES PLASMA
Donald R. Sigman and John J. Reinmann Washington Dec. 1967 13 p refs
(NASA-TM-X-1481) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Calculations were made on the efficiency of using a Stix coil to transfer power to waves near the ion cyclotron frequencies of a cold, collisionless plasma consisting of two ion species. The mass ratio m_b/m_a of the ion species was 2, and the frequency region near and between the cyclotron frequencies (Ω_{ia} and Ω_{ib}) of each ion species was investigated. For wave frequencies ω less than Ω_{ib}, only the usual ion cyclotron resonance absorption peak is obtained. For $\Omega_{ia}>\omega>\Omega_{ib}$, two absorption peaks are obtained. The additional peak corresponds to power absorbed by fast wave modes associated with the heavier species. The wave set up nearer the cyclotron frequency of the lighter ion Ω_{ia} is a left-polarized wave, and power is absorbed primarily by modes whose wavelengths, which are parallel to the static magnetic field, are near the wavelength of the Stix coil. The second absorption peak occurs at lower frequencies where the power is absorbed by the right-polarized fast wave modes associated with the heavier species. There is a sharp cutoff on the low frequency side of this second absorption peak.
Author

N68-11466# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
THE INFLUENCE OF ELECTRICAL RESISTIVITY ON THE MHD STABILITY OF STATIONARY EQUILIBRIA
Helmut Friedel 20 Aug. 1967 17 p refs
(Contract F61052-67-C-0014)
(AFOSR-67-2434; SR-48; AD-660091)

The basis of the stability analysis is a stationary equilibrium characterized by a quasi-aligned field configuration. The first order influence of small electrical resistivity on the stability behaviour of a system stable or marginally stable in zeroth order is given.
Author (TAB)

N68-11482 Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SHOCKS IN MAGNETO-REACTIVE-GAS-DYNAMICS WITH APPLICATION TO THE PISTON PROBLEM [SUR LES CHOCS DANS UN MILIEU MAGNETODYNAMIQUE REACTIF AVEC APPLICATION AU PROBLEME DU PISTON]
1967 110 p refs In FRENCH
(CEA-R-3137)

Four types of detonation and four types of deflagration waves in magnetogasdynamics are considered. The propagation of these waves is not always completely determined by the initial-boundary conditions and the conservation laws across the discontinuity. The piston problem is considered and it is shown that in some cases more conditions must be added to the conservative laws in order to provide sufficient data for the unique determination of the propagation process. It is then shown that the needed additional conditions may be derived from an investigation of the internal structure of the detonation and deflagration process in magnetogasdynamics. This internal structure is investigated for the eight types of process under the influence of the combustion mechanism and the dissipative coefficients (viscosities, electrical and thermal conductivity). Finally all the possible solutions for the piston problem are discussed in a simple case. The methods developed here may be extended to ionizing shocks. Author (NSA)

N68-11516# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.

APPROXIMATIVE SOLUTION OF AN EIGENVALUE PROBLEM OF THE HELMHOLTZ EQUATION USING LIE SERIES

G. Tinhofer 20 Aug. 1967 8 p refs

(Contract F61052-67-C-0014)

(SR-50; AFOSR-67-2435; AD-660090)

Given the set of equations (1): y double prime (x) + k squared (x) y (x) = 0; k squared = k sub 0 squared (1 + the quantity (mu/1 + exp to the x/L power)) the report indicates how eigenvalues (and eigenfunctions) of equations (1) can be evaluated numerically in an easy way by using Lie series. TAB

N68-11525# Atomic Energy Establishment, Winfrith (England).

USE OF DUST SUSPENSIONS IN CLOSED CYCLE MAGNETOHYDRODYNAMIC ELECTRICAL GENERATION SYSTEMS

A. T. Hooper and D. Newby Jul. 1967 32 p refs

(AEEW-M-755) CFSTI: HC $3.00/MF $0.65

A study leading to the selection of a reference design, and its first cost estimates for a closed cycle nuclear MHD plant, is described. The chosen working fluid is a suspension of barium oxide in argon, and the peak cycle temperature is 2000°K. The predicted economics of this cycle offer little incentive to embark on the large amount of development necessary, but the methods used in arriving at this conclusion are relevant to the assessment of other MHD cycles. As the theoretical work was nearing completion, results from the experimental program initiated in the earliest days of the project showed that the physics model for the calculation of electrical conductivity of a dust laden gas is inapplicable under the conditions necessary for MHD work; under these conditions, severe agglomeration problems occur.

Author (NSA)

N68-11526 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuggart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.

PROPAGATION AND ABSORPTION OF ALFVEN- AND CYCLOTRON WAVES IN A PLASMA [AUSBREITUNG UND ABSORPTION VON ALFVEN- UND ZYKLOTRONWELLEN IN PLASMEN]

R. Holzschuh Sep. 1967 54 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-60) CFSTI: $3.00

The present study is on the whole a revision of the literature about Alfvén- and cyclotron waves and their propagation and absorption. It shall be the basis for further considerations such as "Interaction of streaming ionized gases and plasma waves", with special stress to the mechanism of the energy transfer from the plasma to the wave. In that connection we shall especially consider plasma of high particle density. Results obtained from this complex may be used for the construction of an Alfvén wave generator and of an Alfvén wave accelerator. Author

N68-11558 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BORDER CONDITIONS ON THE CONTACT SURFACE OF AN IONIZED GAS AND A SOLID BODY [O GRANICHNYKH USLOVIYAKH NA POVERKHNOSTI KONTAKTA IONIZOVANNYGAZ-TVERDOYETELO]

G. A. Lyubimov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 105–112 refs (See N68-11548 02-34)

It is shown how it is possible to formulate border conditions on the electrode taking into account the physical properties of the electrode material. It is indicated that exact formulation of border conditions depends on distribution of electrical values in the electrode layer, having a thickness less than the length of the free path of an electron. Calculated are the volt–ampere characteristics of the channel at the coarsest assumptions of flow and physical properties of the electrode material. Author

N68-11566 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POSITIVE POLE OF AN ELECTRIC ARC IN A CURRENT [POLOZHITEL'NYY STOLB ELEKTRICHESKOY DUGI V POTOKE]

G. Yu. Dautov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 153–158 (See N68-11548 02-34)

A simplified analysis has been made of electric arc heating in an inviscid, incompressible gas stream (in a positive arc column). The energy equations with and without electrical conductivity are integrated with various simplifying assumptions, such as constant thermal conductivity, electrical conductivity linearly dependent on temperature, and no thermal conductivity in the flow direction. A further simplification is introduced by considering the whole gas flowing in the tube as electrically conducting. Expressions are obtained for the potential drop along the length of the tube, the mean temperature distribution at a given cross section, and the ratio of unit-temperature rise to arc strength. The results indicate that all three variables depend on the tube radius. Author

N68-11567 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THRESHOLD CONDITIONS FOR THE DISTRIBUTION FUNCTION OF CHARGED PARTICLES MAKING FINITE MOTIONS [FRANICHNYYE USLOVIYA DLYA FUNKTSII RASPREDELENIYA ZARYAZHENNYKH CHASTITS, SOVERSHAYUSHCHIKH FINITNYYE DVIZHENIYA]

A. N. Dyukalov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 159–162 refs (See N68-11548 02-34)

This article shows derivation of a continuous solution and also establishes limiting conditions for the distribution function of finite particles. Expressions and equations are used in the article for solution of problems. Author

N68-11568 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF COULOMB INTERACTION OF ELECTRONS WITH IONS OF THE OPTIMUM COMPOSITION OF GAS MIXTURES [VLIYANIYE KULONOVSKOGO VZAIMODEYSTVIYA ELEKTRONOV S IONAMI NA OPTIMAL'NYY SOSTAV GAZOVOY SMESI]

E. P. Zimin and V. A. Popov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 163–166 (See N68-11548 02-34)

An investigation has been made to study conditions of maximum electrical conductivity in a seeded plasma when coulombic interactions are taken into account. The coulombic interactions between electrons and ions are considered as elastic collisions, and

the assumption is made that $n_e << n_2$ (n_e=number of electrons, n_2 total number of atoms). The conductivity equation is written in terms of partial pressures, and conditions for maximum conductivity are found. A detailed study is made for the case of argon seeded with cesium at various temperatures and pressures. In the temperature range under study, the electron-neutral differential collision cross sections were assumed 8×10^{-17} cm^2 for argon and 4×10^{-4} cm^2 for cesium. Author

N68-11589 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN TRANSIENT MOTIONS OF COLD PLASMA [O NEKOTORYKH NEUSTANOVIVSHIKHSYA DVIZHENIYAKH KHOLDNOY PLAZMY]

V. A. Levin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 167–169 refs (See N68-11548 02-34)

An analytical study has been made of unsteady longitudinal motions of a cold electron plasma with various electronic speeds. The dispersion of a plasmoid is used as an application of the derived equations. The ion density is assumed constant and the assumption is made that the plasma fills all space. An expression is derived for electron motion in the plasma, and the results are applied to determine the rate at which a plasmoid boundary moves. It is shown that the results underestimate experimental predictions of plasmoid dispersion. Author

N68-11597# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIATION DURING SCATTERING OF CHARGED PARTICLES ON ELECTROMAGNETIC WAVES OF AN ISOTROPIC PLASMA [IZLUCHENIYE PRI RASSEYANII ZARYAZHENNYKH CHASTITS NA ELEKTROMAGNITNYKH VOLNAKH IZOTROPNOY PLASMY]

A. Gaylitis and V. N. Tsytovich 28 Feb. 1967 26 p refs Transl. into ENGLISH from Lab. Uskoritely, Akad. Nauk SSSR, Fiz. Inst. (USSR), 1964 p 1–30

(Contract AF(657)-14782)

(FTD-HT-67-55; TT-67-63128; AD-659875)

The cross section of scattering of longitudinal waves on an arbitrary charge that is moving in a plasma is calculated taking into account the nonlinearities of the plasma. The change in the cross section of Cherenkov radiation of longitudinal waves by a charged particle that occurs due to nonlinear effects is examined. The obtained results are valid for any velocities of particles and any phase velocities of waves. Through the found cross sections we can then obtain the kinetic equations that describe the nonlinear effects in a plasma of any temperatures, including ultra-relativistic temperatures. These nonlinear equations consider both the effects of the interaction of longitudinal waves and the effects of the nonlinear interaction of transverse and longitudinal waves. The obtained results are used to evaluate the role of nonlinear effects and the acceleration of cosmic rays of plasma waves. Author (TAB)

N68-11662 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE ATTENUATION OF FINITE-AMPLITUDE LONGITUDINAL PLASMA OSCILLATIONS

V. I. Karpman *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 1–11 refs (See N68-11661 02-23)

The effect of weak collisions on finite amplitude plasma wave decay was studied analytically. The Boltzmann equation for the distribution function is derived and rewritten after introducing the nondimensional total energy of a particle in a wave field. The solution is obtained by series expansion and divided into three domains: external, internal, and boundary layer. The boundary layer domain is studied in some detail, with the assumption that variations in the distribution function are small. The resulting equation is then solved for both positive and negative signs, and the damping of waves is estimated. The analysis is extended to a case requiring expansion of the distribution function. The final solution for oscillation damping leads to the linear theory of Landau, for which the Landau damping expression is given. K.W.

N68-11663 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME QUESTIONS REGARDING THE THEORY OF THE ELECTRODE LAYER OF A CHANGE IN POTENTIAL

G. A. Lyubimov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 12–24 refs (See N68-11661 02-23)

The author attempted to refine his previous theory on electric sheath formation by including in his analysis such effects as collision ionization of atoms by electrons and acceleration of electrons in sheath layers. The model consists of a thermionically emitting surface, a Debye length much smaller than the electron mean free path and a linear drop. Comparison of the above with experimental data collected in argon at 2200°K and one atm. pressure with additions of potassium seed indicated a considerably better agreement with experimental data than for analysis done without considering collisional ionization. Author

N68-11664 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INTEGRAL CHARACTERISTICS OF A MAGNETOHYDRODYNAMIC GENERATOR WITH TWO PAIRS OF FINITE-LENGTH ELECTRODES

Ye. K. Kholshchevnikova *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 25–38 refs (See N68-11661 02-23)

The current distribution in an MHD channel with two pairs of finite-length electrodes along its walls separated by isolated sections was calculated. The potential difference between each pair of electrodes may vary. The channel is assumed to extend to infinity in the x direction with width 2δ in the y direction. The length of each electrode is l and the insulator 2λ. The magnetic Reynolds number is assumed to be small, and all induced currents are neglected. The magnetic field is given by $\overline{B} = (0,0,-B_0)$ and the velocity field by $\overline{V} = [V(y), 0,0]$, and σ is constant throughout the channel. It is further assumed that the current is symmetric relative to the x axis, and consequently the flow field is mapped from the z plane onto the τ plane. The currents I_1 and I_2 are defined and obtained in nondimensional forms. Several special cases are considered: (1) l and 2δ fixed and the insulation length approaching zero; (2) the effects of external loads on I_1, I_2, and the generator efficiency; and (3) the effect of channel geometry on I_1, I_2, and I. K.W.

N68-11665 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING PERTURBATIONS OF THE EQUILIBRIUM OF THE CONDUCTING FLUID IN A SPHERICAL CAVITY IN A MAGNETIC FIELD

Yu. K. Bratukhin and M. I. Shliomis *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 39–47 refs (See N68-11661 02-23)

The effect of small perturbations on a conducting fluid with viscosity ν and electric conductivity σ filling a cavity with immovable walls and in the presence of a magnetic field H was studied analytically. Author

N68-11666 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ROTATIONAL RELAXATION OF DIATOMIC MOLECULES IN A LIGHT INERT GAS

M. N. Safaryan and Ye. V. Stupochenko *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 48–58 refs (See N68-11661 02-23)

The rotational relaxation of heavy diatomic molecules (a rigid rotator) was analyzed in a light inert gas under conditions of

strongly nonadiabatic collisions between atoms and molecules with solutions given in terms of generalized Laguerre polynomials. Author

N68-11680 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE INITIAL STAGE OF AN ELECTRICAL DISCHARGE IN WATER

A. I. Ioffe, K. A. Naugol'nykh, and N. A. Roy *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 198–208 (See N68-11661 02-23)

The process of an electric discharge column spreading in water was discussed analytically for small spreading rates and zero magnetic forces. A theoretical model is constructed on the basis of small dR/dt (R–column radius) assumption which leads to linear acoustic approximations that satisfy Laplace's equation $\Delta\phi=0$ and the linearized Euler momentum equation. Dissociative heat transfer in a thin layer around the discharge column is considered to be the primary source of energy loss. Radius versus time and discharge potential versus time curves are calculated using experimentally determined column radii. This is done by means of photographing the discharge. Author

N68-11681 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INTERACTION OF SHOCK WAVES IN AN IDEALLY CONDUCTIVE GAS WITH WEAK MAGNETIC FIELDS

V. P. Korobeynikov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 209–212 refs (See N68-11661 02-23)

The problem is considered of the perturbation of a weak magnetic field H_0 by a strong shock wave propagating in a perfectly conducting stationary ideal gas whose initial density is ρ_0. The gas motion is assumed one-dimensional, the gas-dynamical flow parameters depend only on one coordinate r(and the time t), and the influence of the magnetic field on the perturbed gas motion is neglected. The three cases of spherical, cylindrical, and plane shock waves are considered with ρ_0 and H_0 constant. For the spherical wave the field H_0 is initially directed along the z axis, for the cylindrical wave H_0 is initially direct at an angle α from the z axis, and for the plane wave H_0 initially has the Cartesian coordinates r, y and z. Author

N68-11682 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE MAGNETOHYDRODYNAMICS THEORY OF THE STABILITY OF AN INHOMOGENEOUS IONIZED GAS IN A MAGNETIC FIELD

A. M. Fridman *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 213–221 refs (See N68-11661 02-23)

The stability of small oscillations in equilibrium two-component gas in a magnetic field was investigated. The following assumptions were made: 1) gas pressure much less than magnetic pressure, $nT<<1/8\ H^2/\pi$; 2) the electric field irrotational and arbitrarily small oscillations about the equilibrium position; and 3) quasi-neutral gas. From equations of motion of electrons transverse to the magnetic field, equations of motion for ions and electrons along magnetic lines of force, and ion and electron mass conservation laws, a second-order dispersion equation is obtained. Two limiting cases are discussed: $\omega<\omega_n$ and $\omega>\omega_n$. It is shown that the larger the inequality $k_z<<k_y$ the larger is the instability. Author

N68-11683 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STEADY-STATE FLOW OF AN ANISOTROPICALLY CONDUCTIVE LIQUID BETWEEN PARALLEL POROUS WALLS

I. P. Semenova *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 222–229 refs (See N68-11661 02-23)

A Hartman type flow between two parallel plates was analyzed (including Hall currents arising from anisotropic conductivity). The x, y axes are taken in the plane of the plates and the z-coordinate perpendicular to it. The flow is assumed to be in the x–y direction under constant pressure gradients and an external magnetic field. Fluid is injected from the lower plate and sucked at the upper plate at a constant rate. All magnitudes are assumed to depend on the z-coordinate. The equations of motion and of the current flow are written in two dimensions. A general solution is obtained with velocity components u and v. With the assumption $R_m<<1$ and $w\tau \geq 1$ these equations are simplified and given numerically on the Strela computer. Author

N68-11684 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE JOULE DISSIPATION IN A CHANNEL WITH DIELECTRIC WALLS AND ONE NONCONDUCTIVE PARTITION WHEN A CONDUCTIVE MEDIUM IN AN INHOMOGENEOUS MAGNETIC FIELD FLOWS ALONG THIS CHANNEL

A. B. Vatazhin *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 230–234 (See N68-11661 02-23)

Joule heating in a one dimensional, infinitely long magneto-hydrodynamic channel with a single nonconducting partition was studied analytically. The partition is infinitely thin. The flow velocity is constant and the magnetic Reynolds number is much less than unity. The upper half of the channel is transformed to the upper half-plane by conformal mapping techniques. A Cauchy type integral is obtained which eventually leads to a closed form expression for Joule heating. This shows that the presence of a partition reduces Joule dissipation. Author

N68-11708*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics.

STRUCTURE OF MAGNETOHYDRODYNAMIC SHOCK WAVE

Chung Kung Liu Jun. 1967 66 p refs

(Grant NGR-09-005-025)

(NASA-CR-90537; Rept.-67-028) CFSTI: HC $3.00/MF $0.65 CSCL 20I

This dissertation studies the structure of the plane magnetohydrodynamic shock wave of a rarefied fully-ionized plasma. Both the shock front and the magnetic field are assumed to be perpendicular to the flow direction. In the undisturbed region, the gas pressure can be comparable to, much smaller or much larger than the magnetic pressure, and also the magnetohydrodynamic Mach number (M^*) can be any value greater than unity. Since the plasma is so rarefied that the mean free path here cannot be considered as a relevant scale length for the shock thickness, instead the geometrical mean of the ion and electron Larmor radius is the appropriate one. Under these assumptions, the structure of larger M^* shock wave is solitary wave-like, and that of smaller M^* shock wave can be either oscillatory or monotonic depending on the value of electrical resistivity. Author

N68-11892 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

A 90° LASER SCATTERING EXPERIMENT FOR MEASURING TEMPERATURE AND DENSITY OF THE IONS AND ELECTRONS IN A COLD DENSE THETA PINCH PLASMA [EIN 90°-LASER-STREUEXPERIMENT ZUR MESSUNG VON TEMPERATUR UND DICHTE DER IONEN UND ELEKTRONEN EINES KALTEN, DICHTEN THETA PINCH PLASMAS]

H. Roehr Aug. 1967 42 p refs In GERMAN; ENGLISH summary

(IPP-1/58) CFSTI: $3.00

Temperature and density of the ions and electrons were determined from the ion line in a 90° laser scattering experiment.

In some cases the plasma data were chosen so that only two particles are contained in the Debye volume. Though the scattering theory is derived for the case of many particles in the Debye volume, no deviation from the calculated spectra could be observed. The values of the electron density were confirmed by measurements of the satellite peaks. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-11024*# Auburn Univ., Ala. Dept. of Physics.
AN EXPERIMENTAL INVESTIGATION OF PROPERTIES OF DIELECTRIC MATERIALS FOR USE IN THIN FILM CAPACITORS Final Report, 7 Apr. 1965–7 Oct. 1965
Howard E. Carr, W. D. Foster, T. A. Harbuck, and A. T. Fromhold, Jr. 25 Jan. 1967 70 p refs
(Contract NAS8-20061)
(NASA-CR-90301) CFSTI: HC $3.00/MF $0.65 CSCL 20L

An experimental survey of materials for use in thin film capacitors has been completed. Dielectric properties measured at 300°K are reported for thermally evaporated oxides 300 to 6000 angstroms in thickness of the metals Y, Sc, V, La, Ce, Pr, Nd, Sm, Gd, Dy, Ho, Er, and Yb. Thin evaporated aluminum electrodes were utilized to impress voltages in the range zero to 75 volts across the oxide layers. Dielectric breakdown strengths in excess of 5×10^6 volts/cm were observed. Relative dielectric constants measured for the oxides range from two to twenty, and measured capacitances were as high as 156×10^{-9} farads/cm^2. The oxides of Ce, La, Nd, Gd, Pr, and Er show a great deal of promise as potential materials for use in thin film capacitors. These oxides have therefore been selected for further study. Author

N68-11123# Johns Hopkins Univ., Baltimore, Md.
DYNAMIC MECHANICAL MEASUREMENTS ON VISCOELASTIC SOLIDS Final Report
Edwin R. Fitzgerald 20 Sep. 1967 22 p refs
(Contracts Nonr-248(59); Nonr-4010(08))
(AD-659460)

Contents: Electromagnetic transducer measurement apparatus; Simple (ABC) piezoelectric measurements; Measurements on polycrystalline aluminum; Dynamic mechanical and dielectric measurements on some poly (vinyl esters); Dynamic mechanical measurements on honey; Sound beams from single crystal vibrations; Fatigue tests; Particle wave description of plastic deformation; Analysis of vibration experiments aproximating simple shear; Some dynamics of hexagonal close-packed crystal lattices. TAB

N68-11124# Notre Dame Univ., Ind. Physical Electronics Group
THE SURFACE PHYSICS OF SIMPLE AND COMPLEX ELECTRON EMITTERS Final Report, Nov. 1, 1964–Jul. 31, 1967
Alex A. Petrauskas and Edward A. Coomes 6 Jun. 1967 74 p refs
(Contract Nonr-1623(01))
(AD-660211)

The kinetics of adsorbed layers of KCl on W, Cl on W, Sr on W, O on W, and O on Mo have been investigated in the temperature range 300 degrees K to 1900 degrees K by means of field electron microscopy. The adsorption, desorption, and migration of Sr on W, Ba on W, and Sr on Mo were also examined. The variation of average work function of the surface with coverage, the Gibbs free energy for desorption, and the activation energy for migration around the (110) were measured. The polarizability of Sr was evaluated from four theories of adsorption. Only MacDonald and Barlows theory gave results in agreement with other measurements and computations. For metal surfaces, theory and experiment in second order Schottky effect confirmed the mirror image nature of surface barrier up to distances of few lattice parameters, and has related the energy structure for the electrons in the surface layer to the interior structure of the emitter. Author (TAB)

N68-11127# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
A UNIQUE LASER DETECTOR UTILIZING THE PHOTODIELECTRIC EFFECT IN COOLED SEMICONDUCTORS
Jackie L. Stone and William H. Hartwig 1 Sep. 1967 175 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-67-2138; TR-39; AD-659738)

A change in the real part of the dielectric constant of semiconductors is observable at 4.2K. The dielectric perturbation can be optically induced and subsequently used to vary the resonant frequency of a high Q, superconducting re-entrant cavity. The frequency changes are predictable from a classical treatment of the complex dielectric constant in the presence of optical and thermal carriers. A transmission line equivalent circuit is used to accurately predict the behavior of a photodielectric detector. The important parameters which affect the performance of the detector are the free carrier relaxation time, recombination lifetime, the unloaded cavity resonant frequency, sample thickness, and the capacitive loading effects. These are referred to as the sensitivity parameters. The ultimate frequency response (i.e. the rate at which the frequency can be varied) is shown to be limited by the free carrier lifetime in the semiconductor sample. The photodielectric receiver is used in the design of an optical communications system which was used to detect video rate, amplitude modulation of a 9000A infrared light source. Three such systems are described but practical considerations of the state-of-the-art limit attention to the one utilizing the phase change of a frequency modulated re-entrant cavity. A cryogenic environment was used to suppress thermally generated free carriers and to allow operation of the cavity in the superconducting mode. A 60 ohm-cm, p-type germanium sample was used to detect a video modulated (bandwidth of 1.5 MHz) 9000A light source. Author (TAB)

N68-11148# Mithras, Inc., Cambridge, Mass.
STUDIES OF STRESS CORROSION CRACKING BY THE MOSSBAUER EFFECT Final Technical Report, 1 Feb.–31 Jul. 1967
John H. Terrell, Richard H. Forsyth, and Charles S. Naiman 31 Jul. 1967 33 p refs
(Contract N00014-67-C-0483)
(MC-66-133C-R1; AD-660038)

An investigation into various techniques for carrying out Mossbauer effect (ME) measurements in a non-destructive, in situ manner requiring no sample preparation (backscatter ME measurements) is reported. The research was directed toward detecting the 2% abundant Fe57 nucleus which is common to iron alloys so that environmental changes brought about by stress and/or corrosion could be followed. Comparisons of three backscatter ME experiments which employ different geometrical arrangements of the source, sample, and counter and which detect the 14.4 kev gamma-rays or 6.3 kev internal conversion X-rays are given. It is found that the most efficient technique for performing backscatter ME measurements is to use a geometrical arrangement designated as around-the-corner detecting 6.3 kev internal conversion X-rays. A discussion of the background count rate is given along with a description of an anti-coincidence system which can be used to significantly reduce the background but only for weak sources. Author (TAB)

N68-11210# Navy Electronics Lab., San Diego, Calif.
PERMITTIVITY OF SOLID SOLUTIONS OF BARIUM AND LEAD TITANATE
G. W. Marks and L. A. Monson 30 Jun. 1967 19 p refs
(NEL-1470; AD-659963)

An investigation was made of the effect on the dielectric properties of barium titanate ($BaTiO_3$) by the addition of small percentages (0 to 10 percent) of lead titanate ($PbTiO_3$). Measurements were made at 1 kc/s within the temperature range 0 to 200C. Increase in lead concentration was found to cause a decrease in permittivity, a shift of the Curie point to higher temperatures, and a lowering of the tetragonal to orthorhombic transition temperature. Author (TAB)

N68-11218# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
DEVELOPMENT OF INJECTION ELECTROLUMINESCENT MATERIALS
S. Z. Beer and R. Mazelsky 15 Oct. 1967 55 p refs
(Contract NObs-94326)
(QR-5; AD-660219)

Work was continued on the growth of crystals of aluminum phosphide improved as to size and quality. Work was continued on the growth in tin using the transport of AlP in solution via a temperature gradient. Some difficulty was still encountered in pouring the solvent from the crystals after the growth run due to clogging of the sieve. The majority of the larger crystals grown were used for contacting studies in order that electrical measurements might be made. Czochralski solution growth was started. The primary effort was made in obtaining a suitable seed on which to nucleate growth. High strength polycrystalline material was obtained from hot pressing. A crucible had to be designed to prevent the aluminum phosphide from floating on the tin surface. A partially successful run was made and some growth was obtained. This technique holds considerable potential for the growth of bulk crystals. This report describes the sample preparation, Czochralski growth attempts, and initial electrical measurements on the crystals. Author (TAB)

N68-11226# Battelle Memorial Inst., Columbus, Ohio.
PHASE STABILITY CONSIDERATIONS, STRUCTURAL, MECHANICAL, AND ELECTRONIC PROPERTIES OF HCP TRANSITION METAL ALLOYS IN THE GROUP NUMBER RANGE 6.8 TO 8.4
R. I. Jaffee, R. Viswanathan, J. C. Ho, J. C. Booth, P. S. Rudman et al 15 Sep. 1967 48 p refs
(Contracts Nonr-2547(00); Nonr-3589(00))
(AD-660425)

Contents: Occurrence of various phases in binary transition-metal alloys; Axial ratio in HCP binary transition-metal alloys, c/a; Electronic specific heat coefficient, Experimental, Results, electronic specific heat, Debye temperature, superconductivity; Magnetic susceptibility, Experimental, Results, transition-metal susceptibility, relationship between gamma chi; Hardness of transition-metal alloys, Alloys measured, alloys of 5d transition metals, other transition-metal alloys, Results, alloys of 5d transition metals, other transition-metal alloys. TAB

N68-11256# Notre Dame Univ., Ind. Physical Electronics Group.
A FIELD-ELECTRON EMISSION DETERMINATION OF THE WORK FUNCTION OF THE TUNGSTEN (211) PLANE
John H. Dinan, Alex A. Petrauskas, and Edward A. Coomes 15 Sep. 1967 18 p refs
(Contract Nonr-1623(01))
(AD-660210)

A value of 6.9 plus or minus 0.5 eV has been measured for the work function of a (211) plane of a thermally-smoothed tungsten field emitter. A retarding-potential analyzer was used to obtain Fowler-Nordheim data and total-energy distributions at room temperature. A family of energy distributions has been employed according to the method of Young in order to take into account the presence of patch fields at the surface of the emitter. This value is larger by 1.5 to 2.0 eV than those determined by other methods. Author (TAB)

N68-11329# Syracuse Univ., N. Y. Dept. of Chemistry.
FLUCTUATION PHENOMENA AND PHASE TRANSITIONS IN CONDENSED SYSTEMS Technical Report, 1 Oct. 1966–30 Sep. 1967
Harry Brumberger 20 Oct. 1967 24 p refs
(Contract Nonr-669(19))
(TR-3; AD-660222)

The report describes progress made in investigating the critical scattering of X-rays by the binary metallic liquid system Na-Li, and scattering of light from $BaTiO_3$ near the ferroelectric Curie point. Some scattering experiments near the alpha-beta transition of quartz are also described. The Na-Li scattering does not appear to follow Ornstein-Zernike behavior, but further experiments are needed. $BaTiO_3$ shows definite hysteresis effects in the light-scattering, and an increase in intensity near Tc. No special scattering effects are observed so far for quartz near the alpha-beta transition temperature. Author (TAB)

N68-11335# Norwegian Inst. of Tech., Trondheim. Div. of Physical Electronics.
ELECTROMAGNETIC PROPERTIES OF DRIFTED SEMICONDUCTOR PLASMAS. PART 2: ENERGY, POWER, AND ACTIVE PROPERTIES
Tore Wessel-Berg Jun. 1967 48 p refs
(Contract AF 61(052)-907)
(AE-4, Pt. 2; ELAB-87, Pt. 2; RADC-TR-67-580; AD-660101)

The report deals with energy and power relations in semiconductor materials with drifting majority carriers. Active properties are discussed on the basis of the time-average electromagnetic power density of plane waves characterized by real frequencies. The report emphasizes the effect of drift current, which causes the conductance to differ from the conductivity. The conductance matrix, evaluated from the dynamic equations, is used to establish simple criteria for active behavior. These criteria express the active properties in terms of the phase velocity relative to the drift velocity. The different dissipation characteristics of irrotational and solenoidal waves are emphasized, and exemplified by the carrier waves and electromagnetic waves in a semiconductor. With two waves propagating in the medium, the active properties are modified due to the cross-power arising from interaction between the waves. The various effects arising from the interaction are discussed. Author (TAB)

N68-11405# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SURVEY OF OPTICAL EFFECTS IN SEMICONDUCTORS
Richard B. Thomas, Jr. Nov. 1967 13 p refs
(R67SD64)

The physics of infrared absorption in semiconductors and processes which influence this absorption are discussed. The sensitivity of the absorption to the relative width between the valence and conduction bands is considered in detail. The effect of an applied electric field on the structure of the absorption is described along with the possible influence of surface impurities. The present of surface impurities leads to the formation of additional bound states lying in the region between the valence and conduction bands and causes a marked decrease in the sensitivity. The complications resulting from the use of ionic crystals is discussed. Here the carriers become what are most usually called polarons (a complex of an electron or hole together with its surrounding polarization in the crystal). The influence of such additional properties of the carrier on the absorption mechanism is considered. Finally the presence of very energetic carriers (hot-electrons) and the importance of traps is discussed. Author

N68-11417* Scientific Translation Service, La Canada, Calif.
X-RAY SPECTRA, ELECTRON STRUCTURE, AND PROPERTIES OF METALLIC COMPOUNDS OF TITANIUM [RENTGENOVSKIYE SPEKTRY, ELEKTRONNAYA STRUKTURA I SVOYSTVA METALLICHESKIKH SOYEDINENIY TITANA]
S. A. Nemnonov and K. M. Kolobova Washington NASA Nov. 1967 16 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 22, no. 5, 1966 p 680–692
(Contract NASw-1496)
(NASA-TT-F-11368) CSCL 20L

This article presents the results derived from studying the X-ray spectra of the emission (secondary excitation method) and absorption of titanium in metal-like compounds of $TiH_{1.83}$ TiB_2, TiC, TiN and TiO. The multiband structure of the energy spectrum, which is apparent in a wide energy interval of 25–30 eV encompassing the 2s-, 2p-valent states of the metalloid and the 8d-, 4sp-state of titanium, closely coincides with the results derived from present-day theoretical calculations. Author

N68-11420# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
DEVELOPMENT OF INJECTION ELECTROLUMINESCENT MATERIALS Quarterly Report
R. Mazelsky and S. Z. Beer Jul. 1967 8 p
(Contract NObs-94326)
(QR-4; AD-660004)

Good crystals of aluminum phosphide were grown by transport via a thermal gradient in tin solution. It was determined that a 25 degree gradient at 1200C results in transport that is too rapid for slow nucleation and the average crystallite size is in the 3 mm range. However, several of these are of high quality with well developed facets and some physical properties will be determined in the next quarter. Studies of growth at lower temperature gradients will be studied. A Czochralski apparatus was modified for pulling crystals of aluminum phosphide from tin solution. Author (TAB)

N68-11439* Watkins-Johnson Co., Palo Alto, Calif.
STUDY OF MILLIMETER BULK SEMICONDUCTOR EFFECTS Final Report
Keith D. Gilbert and Robert M. Malbon 24 Oct. 1967 92 p refs
(Contract NAS12-24)
(NASA-CR-86007) CSCL 20L

A literature search and theoretical considerations led to a choice of nonlinear mixing of two optical frequency signals as a method of millimeter wave generation to be investigated experimentally. A high-resistivity semiconductor of suitable band-gap proved to be the most efficient material. Mixing experiments covered a wide range of output difference frequencies. Semiconductor diode lasers and pulsed ruby lasers served as optical frequency sources. High-resistivity GaAs was used as the nonlinear mixing material. Microwave energy was coupled out of the detector by mounting it in a waveguide. Detection systems ranged from a simple crystal detector to a low-noise traveling wave tube amplifier followed by a crystal detector and amplifiers. Using the pulsed ruby laser, microwave output signals were generated at frequencies up to 90 GHz, with peak powers in the milliwatt range. Results indicate that photoconductive mixing is the nonlinear mechanism responsible for the microwave difference frequency generation. The semiconductor laser experiments were unsuccessful because of a combination of insufficient laser power and excessive signal bandwidths. K.W.

N68-11467# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WORK FUNCTIONS OF W-HF, TA-HF, NB-HF, RE-HF, RE-ZR AND W-RE ALLOYS [RABOTA VYKHODA SPLAVOV W-HF, TA-HF, NB-HF, RE-HF, RE-ZR, W-RE
B. Ch. Dyubua and O. K. Kultashev 3 May 1967 17 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 21, no. 3, 1966 p 398–402
(Contract AF 33(657)-16408)
(FTD-HT-66-766; TT-67-63254; AD-660439)

The paper presents data on the work function of refractory metals in which various amounts of hafnium and zirconium have been dissolved. The work function was determined from the Richardson-Dushman equation for A = 120.4 A/sq cm deg. to the 2nd power. The thermionic emission measurements were carried out in a vacuum of 10 to the minus 8th power - 10 to the minus 9th power mm Hg. The phase composition of the alloys was determined by microstructural analysis. The work function of pure Re, Ta, Nb, and Zr was shown to remain constant with changing temperature. The addition of hafnium and zirconium was found to decrease the work function of the refractory metals. The cause of this effect is thought to be the adsorption of hafnium and zirconium atoms on the surface of the solid solution. In the region of the sigma phase of the W-Re alloy an increase in work function up to 5.0 eV was observed. This is attributed to a possible adsorption of rhenium. Author (TAB)

N68-11492# California Univ., Livermore. Lawrence Radiation Lab.
PIEZOELECTRIC EFFECT IN SHOCKED SUCROSE
J. R. Hearst and E. B. Royce 9 Jun. 1967 7 p refs Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-70485) CFSTI: HC $3.00/MF $0.65

Slabs cut from sucrose crystals were mounted on 7.5-cm gun targets. The gun was fired and open-circuit voltage recorded in the same manner as in the tourmaline experiments. A plot of charge release vs longitudinal stress component in the aluminum gives a straight line of 0.88×10^{-8} C/cm^2/kbar and a nonzero intercept. The dynamic yield strength Y is tentatively calculated to be 3.3 kbar. NSA

N68-11603 Joint Publications Research Service, Washington, D. C.
HUNGARIAN BASIC RESEARCH ON SEMICONDUCTORS
Gyorgy Szigeti *In its* Rept. of the Tech. Sci. Dept. of the Hung. Acad. of Sci. 30 Nov. 1967 p 22–50 (See N68-11601 02-34)

Semiconductor basic research efforts and their effect on Hungarian industry are considered in an overview of surface phenomena, industrial processes, and solid state physics developments. Epitaxial and crystal growth related to semiconductor devices is noted, and mention is made of various metallic crystals that satisfy the requirements of industry and production development. M.W.R.

N68-11660# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
PERIODICITY IN THE TRANSITION TEMPERATURE OF HELIUM 2 IN A ROTATING ANNULUS [PERIODICITA NELLA TEMPERATURA DI TRANSIZIONE DELL'ELIO 2 IN UN ANELLO ROTANTE]
E. Tabet 7 Sep. 1967 9 p refs
(ISS-67/24) CFSTI: HC $3.00/MF $0.65

A simple treatment is given of the behaviour of superfluid helium in a rotating annulus. In strict analogy with superconductors, a periodicity in the transition temperature with respect to the angular velocity results. Author

N68-11809* Martin Co., Baltimore, Md. RIAS Div.
EXPERIMENTAL INVESTIGATION OF ELECTRON–PHONON INTERACTIONS IN SEMICONDUCTORS Quarterly Progress Report, 1 Jul.–30 Sep. 1967
Joseph P. Martin Oct. 1967 28 p refs
(Contract NAS8-21046)
(NASA-CR-90540; QPR-3) CFSTI: $3.00 CSCL 20L

The installation of a system for growing thin film piezoelectric transducers was completed, and films of CdS were grown on quartz, glass, and InSb substrates. It was found that the cleaning procedure was very critical in the production of uniform films. The thickness uniformity has been found excellent by observation of interference patterns in monochromatic light. One film deposited on an InSb substrate has been examined by electron diffraction and appeared to be completely randomly oriented. On the other hand, a film deposited on a glass disc was similarly examined and found to consist of many small crystallites but with their z-axes well oriented normal to the substrate surface. A film deposited on a z-cut quartz rod was tested for acoustic transduction in the microwave acoustics system and found to be very inefficient. Comparative theoretical predictions for acoustic attenuation and gain in InSb were calculated using the theories of Spector and of White. The theory of Spector is calculated on the basis of the Boltzman transport equation and using degenerate electron statistics. Author

N68-11878*# Stanford Univ., Calif. Microwave Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF COLLECTIVE MICROWAVE PHENOMENA IN SOLIDS
Semiannual Status Report, 1 Apr.–30 Sep. 1967
M. Chodorow Nov. 1967 19 p refs
(Grant NGR-05-020-165)
(NASA-CR-90751; ML-1599; SASR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Several two-port amplifier configurations have been tested experimentally, starting from GaAs of nominal resistivity 600 ohm-cm. The rf experiments were conducted in a frequency range from 500 to 2000 MHz. A theory has been developed on noise and uses a hypothesis of field dependent trapping which requires practical corroboration. Means are now being examined for the development of materials with parameters which may be accurately measured and controlled. The apparatus to make the material is being procured, and measurement techniques for deep level traps are being sampled out. The possibility of using electrostrictive materials for acousto-electric amplification is considered. The properties of one such material, reduced $SrTiO_3$, are suitable for amplification above 1 GHz at low temperatures. Preliminary attempts to produce material of the required resistivity are reported. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-11296* Stanford Research Inst., Menlo Park, Calif.
THE RESULTS OF LONG-TERM STORAGE TESTS FOR COMPATIBILITIES OF SPACECRAFT MATERIALS WITH HYDRAZINE AND HYDRAZINE MIXTURES
R. F. Muraca, J. S. Whittick, and C. A. Crutchfield 1 Oct. 1967 85 p ref Prepared for JPL
(Contract NAS7-100; JPL-951581; SRI Proj. ASD-6063)
(NASA-CR-90336; SRI-951581-6) CSCL 21I

The results of compatibility tests are summarized for various metallic and polymeric specimens which had been stored in sealed capsules with hydrazine, hydrazine–hydrazine nitrate, and hydrazine–UDMH at 110°F for periods of about 2 to 4 years. It was found that platinum, an aluminum alloy, and an ethylene–propylene polymer were compatible with hydrazine; and an aluminum alloy and some specially-treated titanium alloys were compatible with hydrazine–hydrazine nitrate. Only one titanium alloy was tested with hydrazine–UDMH and it was determined to be incompatible. The corrosion rates of all specimens in the amine fuels were less than 3 μin/yr. Examination of the storage tests included analyses of fuel compositions and ullage gases, microscopic study of specimen surfaces, and measurements of ullage gas pressures and volumes, specimen weights, and fuel weights. Compatibility ratings were established with reference to the decomposition rates (and pressures) of hydrazine control samples. It is shown that under the storage conditions imposed, hydrazine decomposition proceeds preponderantly according to the equation: $3\ N_2H_4 \rightarrow 4\ NH_3 + N_2$. Author

N68-11645*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF GRAVITY ON SELF-PRESSURIZATION OF SPHERICAL LIQUID-HYDROGEN TANKAGE
John C. Aydelott Washington Dec. 1967 21 p refs
(NASA-TN-D-4286) CFSTI: HC $3.00/MF $0.65 CSCL 13D

The information obtained from several experimental programs was examined in order to understand better the thermodynamic history of spherical, 9-inch- (23-cm-) diameter liquid-hydrogen tankage at both normal and reduced gravities. The rate of pressure rise in the hydrogen container was lower under reduced-gravity conditions than under normal-gravity conditions because of the increase in the liquid-wetted wall area and the increased boiling. The location of the sources of heat relative to the hydrogen liquid and vapor was the most important factor in determining the rate of pressure rise. Author

N68-11760# Naval Research Lab., Washington, D. C.
FLAMMABILITY PROPERTIES OF HYDROCARBON FUELS, PART 2: THE IMPORTANCE OF VOLATILE COMPONENTS AT LOW CONCENTRATION ON THE FLAMMABILITY OF LIQUID FUELS
Wilbur A. Affens 10 Jul. 1967 18 p refs
(NRL-6578; AD-657455)

It was demonstrated by a simplified treatment that vapor pressures of individual constituents play a more important role than concentration on the overall flammability properties of hydrocarbon mixtures. This treatment is based on the application of Raoult's and Dalton's laws governing vapor pressure and composition above a solution of two or more liquid hydrocarbons to Le Chatelier's rule governing the flammability of vapor mixtures. The most important conclusion demonstrated by the derived equations is that a very small amount of highly volatile contaminant in a relatively nonflammable fuel may make it flammable. The amounts needed can be predicted from the equations and the properties of the components. Although precise relationships have been derived only for relatively simple solutions of pure hydrocarbons, the concepts they imply are applicable to more complex mixtures such as jet and diesel fuels. The flammability properties included in this study are lower and upper flammability limits, flash points, and flammability indices of liquid solutions. Author (TAB)

N68-11766 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
PACKING DENSITY AND VISCOSITY LIMITATIONS IN ACHIEVING HIGH SOLIDS CONTENTS IN CASTABLE ROCKET PROPELLANTS
G. L. Duchesne and J. Ratte Dec. 1966 58 p refs
(CARDE-TR-568/66) CFSTI: HC $3.00

The processing characteristics of polyurethane and polybutadiene composite propellants highly loaded with solids are discussed. The solid and liquid phases parameters are first reviewed separately, and the properties of the propellant suspension as a whole are considered. Great importance is attached to the packing properties of the solid system since they load to improved processability. Ammonium perchlorate bimodal distributions of 400 and 200 micron materials combined with 15 to 20 percent by

weight of spherical aluminum yielded castable propellants containing between 84 and 85 percent solids, with both polyurethane and polybutadiene binder systems. A locally developed procedure for checking the packing characteristics of powders is described. Interesting correlations between the packing properties of solids particles and the mix viscosity are also presented. Author

N68-11813 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
LONGITUDINAL COMBUSTION INSTABILITY: BEHAVIOR OF PROPELLANTS WITH HIGH SOLIDS CONTENT
A. K. Roberts, W. A. Bergman, and W. G. Brownlee Feb. 1967 16 p refs Presented at the 3rd Interagency Chem. Rocket Propulsion Group Combust. Conf., Cocoa Beach, Florida, 17–19 Oct. 1966
(CARDE-TN-1746) CFSTI: $3.00

Investigations involved aluminized ammonium perchlorate–polyurethane binder propellants containing up to 84 percent solids content; firings were conducted in 8-in. diameter by 80-in. long and 4-in. diameter by 34-in. long motors. Propellant grains with tubular perforations were used to determine the effect of motor size on the important parameters associated with nonlinear longitudinal mode combustion instability: the critical pressure, the degree of instability, the wave strength and the wave frequency. A comparison was made between the unstable behavior of tubular and slotted-tubular propellant grain configurations in the 4-in. diameter motor. The slotted-tubular configuration, while adhering to many of the trends previously observed with the tubular configuration, also exhibited some important differences. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-11043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF COMBUSTOR PARAMETERS ON THE STABILITY OF GASEOUS HYDROGEN–LIQUID OXYGEN ENGINE
C. E. Feiler Washington 1967 12 p refs Presented at the 4th Combust. Conf., Menlo Park, Calif., 2–13 Oct. 1967 Sponsored by the Interagency Chem. Rocket Propulsion Group
(NASA-TM-X-52360) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Stability limits from the response factor model have been obtained for variations in chamber pressure, flow rate, throat area, and oscillation frequency for a fixed injector element geometry, and are compared with experimental data. The calculated limits were obtained under the assumption that, except for frequency, these variables would not affect the nozzle or liquid oxygen response factors. The comparison of experiment and analysis showed very good agreement which supports the assumption. For constant operating parameters, the stability limit defined by the hydrogen density at transition exhibited a minimum when plotted against frequency. Thus, at a low enough hydrogen density, instability should not occur at any frequency, while at some higher density, an upper and lower frequency limit is predicted. Author

N68-11044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EXPERIMENT ON PARTICULATE DAMPING IN A TWO-DIMENSIONAL HYDROGEN–OXYGEN COMBUSTOR
Marcus F. Heidmann and Louis A. Povinelli Washington 1967 12 p refs Presented at the 4th Combust. Conf., Menlo Park, Calif., 2–13 Oct. 1967 Sponsored by the Interagency Chem. Rocket Propulsion Group
(NASA-TM-X-52359) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Aluminum particles (5μ mean diameter) were injected into a small circular combustor by a secondary flow process used for transverse mode stability rating. Small mass concentrations of aluminum were found to be effective in suppressing instability. A critical concentration of 2/100 percent was noted below which the effect was destabilizing. Author

N68-11176* Martin Co., Denver, Colo.
STERILIZABLE LIQUID PROPULSION SYSTEM Quarterly Progress Report
F. Brady, J. Keough, J. Robinson, and D. Di Stefano Oct. 1967 87 p Prepared for JPL *Its* Issue 4
(Contracts NAS7-100; JPL-951709)
(NASA-CR-90333; MCR-67-15; QPR-4) CSCL 21H

A module truss was completed for a sterilizable bipropellant liquid propulsion system exposed to ethylene oxide. Problems were experienced with the assembly of the oxidizer propellant tanks which contain Teflon laminate hemispherical diaphragms. The first six cycles of heat sterilization and functional testing of phase II components were completed. During the sixth cycle a leak was detected in the oxidizer tank diaphragm; and some degradation was noted in the performance of the regulator during post sterilization functional testing. M.W.R.

N68-11190* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF HYDROTEST FAILURE OF THIOKOL CHEMICAL CORPORATION 260-INCH-DIAMETER SL-1 MOTOR CASE
John E. Srawley and Jack B. Esgar Washington NASA Jan. 1966 84 p refs
(NASA-TM-X-1194) CFSTI: $3.00 CSCL 21H

This investigation concerns the motor case failure during hydrotest at a pressure of 542 psi, which was about 56% of proof pressure. The motor case was constructed of 250-grade maraging steel plate joined mostly by submerged arc automatic welding. A defect not detected by nondestructive testing prior to aging caused the failure. Nondestructive testing was not conducted between aging and hydrotest. The defect causing the failure was in the heat-affected zone of a longitudinal submerged arc weld on the cylindrical section of the motor case in an area repaired by a manual TIG weld. Although the detailed mechanism of the formation of these defects has not been established, it is reasonably certain that their formation was a consequence of the TIG weld repairs to the original welds. A limited test program established that radiographic and ultrasonic procedures for detecting tight fatigue cracks in flat plate specimens are much less sensitive and reliable than expected. It is concluded that nondestructive testing techniques at present are inadequate for detecting small defects in thick pressure vessel walls when identical or similar materials and techniques are involved. K.W.

N68-11297# Aerospace Corp., El Segundo, Calif. Vehicle Systems Dept.
THE EFFECTS OF OUTAGE ON PERFORMANCE STATISTICS FOR BIPROPELLANT ROCKETS
Joseph W. Duroux Jul. 1967 67 p refs
(Contract F04965-67-C-0158)
(TR-0158(3116-50)-1; SAMSO-TR-67-11; AD-659741)

The distribution of performance errors in bipropellant rockets is determined as a function of engine and propellant loading parameters, and contributing errors. The distribution is found to be highly skewed, so that the probability of exceeding three sigma can be significantly greater than it would be if the distribution were

normal. Thus, three sigma as a minimum performance limit is not justified. A detailed analysis is required in each case to determine the relationship between performance margin and probability of mission success. Also, a realistic method of optimizing the propellant loading bias is developed. The methods previously used have resulted in fuel biases that are usually much lower than the optimum. Computer programs have been developed to perform the analyses described in this report, both for the single-stage and the multistage case. Author (TAB)

N68-11581 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
EVALUATION OF SELECTED NOZZLE MATERIALS FOR FOUR-INCH DIAMETER ROCKET MOTORS
F. A. Christie May 1967 33 p refs
(CARDE-TN-1757) CFSTI: $3.00

Six plastic materials were molded into billets and, along with two graphite cylinders, machined into eight nozzles of identical shape. Erosion rates at the nozzle throat were calculated for the duration of the firings. For the plastic nozzles, longitudinal erosion distributions were measured by sectioning the six molded billets. Tentative recommendations for satisfactory nozzle materials are presented, but further work is required to determine the reproducibility and the effect of the motor grain cross section on local erosion rates. Author

N68-11584 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
PROCESSING OF THE 23KS20000 MOTOR
J. Ratte and B. Demers Sep. 1967 33 p refs
(CARDE-TN-1758/67) CFSTI: $3.00

During the final development phase of the 23KS20000 rocket motor eighteen motors were filled, each with 2080 lb of aluminized polyurethane/ammonium perchlorate propellant. Processing data relative to the motor casings, the propellant chemical ingredients and the grain restriction system are presented. The effect of the Teflon-coating process upon the final straightness of the casting mandrel is briefly depicted. Finally, the major processing modification, the preparation of bimodal oxidizer without the oxidizer anticracking agent, is discussed at length. Author

N68-11585*# Martin Co., Denver, Colo.
LIGHTWEIGHT PRESSURIZATION SYSTEM FOR THE APOLLO SERVICE PROPULSION SYSTEM Final Report
D. N. Gorman and G. R. Page Jan. 1967 296 p
(Contract NAS9-3521)
(NASA-CR-65837; CR-66-44) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Several pressurization system concepts were investigated in order to recommend a system for use in the Apollo service propulsion system (SPS), and feasibility of the selected system concept was demonstrated. Storing helium cryogenically was found a necessary requisite for achieving significant weight reduction in the Apollo SPS pressurization system, and a cryogenic helium cascade system was recommended as the optimum system. When actual Apollo mission duty cycles were simulated, cascade system test results were better than predictions by an analytical model. Because of propellant freezing, however, the present Apollo propellant feedline heat exchangers were not found suitable for use at liquid hydrogen/helium temperatures. Results are included for the cascade pressurization system primary tank support structure and tubing heat link investigations; as well as for applications to 34-day, 90-day, and extended missions. M.W.R.

N68-11829*# Israel Program for Scientific Translations, Ltd., Jerusalem.
RUSSIAN SOLID-FUEL ROCKETS [RAKETY NA TVERDOM TOPLIVE V ROSSII]
V. W. Sokol'skii 1967 242 p refs Transl. into ENGLISH from Izd. Akad. Nauk SSSR (Moscow), 1963 Prepared for NASA and NSF
(NASA-TT-F-415; TT-66-51152) CFSTI: $3.00 CSCL 19G

A history of solid fuel rocketry in Russia is presented. Consideration is given to pyrotechnic rockets before the beginning of the 19th century, the earliest military application of rockets, rocket armament of the Russian army, other types of rockets in the second half of the 19th century, attempts to power aircraft by solid propellant rockets, and solid propellant rockets in Russia at the turn of the 20th century. C.T.C.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-11202# American Science and Engineering, Inc., Cambridge, Mass.
RESEARCH DIRECTED TOWARD MEASUREMENT OF THE ENERGETIC CHARGED PARTICLE ENVIRONMENT IN NEAR-EARTH SPACE Final Report, 1 Oct. 1965–15 Dec. 1966
W. C. Hadley, F. R. Paolini, W. P. Reidy, and P. R. Ruby 1 Sep. 1967 127 p refs
(Contract AF 19(628)-5709)
(ASE-1435; AFCRL-67-0231; AD-659754)

Instruments for OV2-1, OV2-3, and OV3-1 satellites were modified, refurbished, retested, and recalibrated. Field assistance was provided at systems test, integration, and launch of the above satellites and of three instrument packages for Astrobee vehicles. Engineering evaluation was carried out where successful launch permitted. Satellites OV2-1 and OV2-3 failed to achieve orbit, but OV3-1 was successfully placed in orbit on 22 April 1966. The instruments on this satellite measure protons from 30 ev to 120 MeV and electrons from 30 ev to 5 MeV, with few gaps over the ranges. Post launch engineering evaluation indicates that all of the instruments except one, the proton spectrometer, are operating. Author (TAB)

N68-11254*# Avco-Everett Research Lab., Everett, Mass.
INVESTIGATION OF MAGNETOSPHERIC PHYSICS Technical Status Report, Period Ending 31 Mar. 1967
C. F. Kennel and H. E. Petschek 31 Mar. 1967 19 p refs
(Contract NASw-1400)
(NASA-CR-90221) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A theory of the coupling of the neutral sheet plasma flow to particle precipitation to form the nightside auroral zone can be constructed using only the most generalized properties of plasma turbulence. Several features, the pitch angle isotropy of the auroral precipitation, the location of separate precipitation maxima for ions and electrons, and the acceleration of high energy particles, are described by this model. The properties of the specific mode of plasma turbulence are still somewhat unclear, since the auroral zone plasma has a large ratio of plasma to magnetic pressure, a case not extensively studied thus far in the fusion literature. Author

N68-11358# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE ENERGY DEPENDENCE OF THE FRAGMENTATION PARAMETERS AND INTERACTION MEAN FREE PATHS IN NUCLEAR EMULSION FOR HEAVY COSMIC RAY NUCLEI
Timothy E. Cleghorn (M.S. Thesis) 1967 80 p refs
(Contract Nonr-710(60))
(CR-104; AD-659992)

It is generally assumed that the fragmentation parameters and absorption mean free paths used in extrapolating the charge spectrum of cosmic ray nuclei to the top of the atmosphere are independent of energy. However recent results suggest that these quantities are not energy independent in hydrogen, and thus it becomes of interest to determine whether they are in an air or heavy element medium. This report describes measurements of the fragmentation parameters and interaction mean free paths of VH nuclei in emulsion for primary energies up to about 30 BeV/n. Also measured was the mean free path of the fragment nuclei with Z = or > 3, produced in interactions in the emulsion. The predicted values of the mean free paths in air are compared with recent measurements by other workers. TAB

N68-11451# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOLAR X-RAY EMISSION SIGNALS ASTRONAUT RADIATION DANGER

D. Michaels *In its* Foreign Sci. Bull., Vol. 3, No. 10 Oct. 1967 p 15–22 (See N68-11449 02-34)

Recent investigations indicate that the monitoring of solar X-ray emissions may aid in the establishment of a reliable flare warning system to ensure astronaut safety. Reportedly Kosmos-166 has confirmed earlier findings by Elektron-2 on the occurrence of X-ray bursts in connection with dangerous corpuscular flares. A survey of recent Soviet reports indicates Kosmos-166 represents a significant technological advance towards, if not the achievement of, a flare warning system based on the monitoring of solar X-radiation. Author

N68-11628*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INTERACTION OF THE MAGNETIZED SOLAR WIND WITH THE MOON

Y. C. Whang Nov. 1967 29 p refs

(NASA-TM-X-63046; X-612-67-580) CFSTI: $3.00 CSCL 03B

In July 1967 the Explorer 35 spacecraft was launched into a lunar orbit to study the interaction of the magnetized solar wind plasma with the moon. The experimental results indicate that a detached bow shock wave does not exist in the vicinity of the moon. Thus the flow conditions near the moon do not resemble those near the earth's magnetosphere. In this paper the solar wind flow around the moon is treated theoretically as a free molecule flow of magnetized plasma. Analytical results are obtained to describe the distribution of the ion density and the ion flux in the vicinity of the moon. A sizable empty cavity is produced in the near-downstream vicinity of the moon; across the boundary of the cavity the plasma flow changes rapidly from the undisturbed condition to the void condition. The disturbed region in the downstream forms a long wake on the dark side of the moon. The direction of the wake is deflected slightly toward the field lines. The thickness of the wake, measured perpendicular to the plane of the solar wind velocity and the interplanetary magnetic field, is constant at one lunar diameter. On the other hand, the width of the wake, measured parallel to that plane, increases with distance from the moon. The length of the wake is of the order of 100 lunar radii. Author

N68-11797* State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

SPECTRAL, SPATIAL, AND TEMPORAL VARIATIONS OBSERVED FOR OUTER ZONE ELECTRONS FROM 10 TO 100 KEV WITH SATELLITE INJUN 3

Theodore A. Fritz (Ph.D. Thesis) Aug. 1967 204 p refs

(Grant NsG 233-62; Contract Nonr-1509(06))

(NASA-CR-90510; Rept.-67-42) CFSTI: $3.00 CSCL 04A

Spectral, spatial, and temporal variations of outer zone electrons with energies from 10 keV to 100 keV observed with Injun 3 are presented. Electrons with $E_e \geq 40$ keV were constantly observed precipitating into the atmosphere for all latitudes, $\Lambda \geq 45°$. At latitudes below the high latitude boundary, the flux of ≥ 40 keV electrons in the loss cone was observed to always be $\approx 10^{-2}$ that of the locally mirroring flux. There was usually a spike of precipitating ≥ 40 keV electrons observed at the high latitude boundary and the flux of ≥ 40 keV electrons was usually observed to approach isotropy over the upper hemisphere at the position of the satellite at this boundary. Large intensities of electrons with energies not much greater than 40 keV were observed precipitating into the atmosphere for $\Lambda \geq 65°$ during magnetically quiet periods and the position of the high latitude outer zone boundary (intensity cutoff) was observed to vary by $\Delta\Lambda \approx 7°$ while no magnetic activity was occurring. The latitude where the ratio of the trapped to the precipitated ≥ 40 keV particle fluxes breaks from 10^{-2} toward one is introduced as a more meaningful concept of the high latitude limit to durably trapped ≥ 40 keV electrons than the usual intensity cutoff. Author

N68-11826*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

THE ARTIFICIAL ELECTRON BELT, OCTOBER 1963 TO OCTOBER 1966

D. S. Beall 14 Jul. 1967 16 p ref

(NASA Order R-21-009-004)

(NASA-CR-90542) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Satellite 1963 38C, launched September 28, 1963 into a polar orbit at 1100 km, continues to operate normally as of July 1967. The measured decay of the Starfish electron radiation belt is discussed for over a 36-month period commencing 15 months after the Starfish high altitude nuclear detonation of July 9, 1962. It summarizes the main results of a 27-month study and extends the time coverage to a full 3 years. The latest data collection interval occurs in October 1966. A table lists all the intervals for which data are presented. Author

N68-11830*# Naval School of Aviation Medicine, Pensacola, Fla.

RADIATION MONITORING WITH NUCLEAR EMULSIONS ON PROJECT GEMINI. 3: THE FLUX OF GALACTIC HEAVY PRIMARIES ON GEMINI 7

Hermann J. Schaefer and Jeremiah J. Sullivan 29 Sep. 1967 17 p refs Prepared jointly with NASA

(NASA-CR-90107; NAMI-1017) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Earlier evaluations of small nuclear emulsion sheets flown on the astronauts' bodies during the 14-day Gemini 7 mission had been limited to grey tracks which allowed grain counting. This report provides data on the population of heavy tracks. By comparing visual appearance of the diameter of the solid silver core and of the delta ray aura with tracks of known Z, tracks of $Z \geq 20$ were identified and counted. A total of 287 such tracks yielded a mission flux of 38.4 nuclei/cm^2 of $Z \geq 20$, corresponding to a tissue dose of 1.35 millirads. Theoretical assessment of the flux by considering the geomagnetic latitude profile of the mission leads to 74.8 nuclei/cm^2 of $Z \geq 20$. The difference closely matches the expected attenuation due to the inherent shielding of the vehicle and the self-shielding of the astronauts' bodies if one assumes a collision mean free path of 14 g/cm^2 for nuclei of $Z \geq 20$. The results confirm earlier estimates that galactic heavy nuclei contribute less than 5 per cent to the total absorbed dose. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-11012*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

DEVELOP A ZERO-G, DRAG-FREE SATELLITE AND PERFORM A GYRO TEST OF GENERAL RELATIVITY IN A SATELLITE Semiannual Status Report, Nov. 1965–Apr. 1966

Robert H. Cannon, Jr. and Benjamin O. Lange May 1966 32 p refs

(Grant NsG-582)

(NASA-CR-90219; SASR-5) CFSTI: HC $3.00/MF $0.65 CSCL 22A

During this reporting period emphasis was placed on the aeronomy experiment satellite flight plan, control system analysis and simulation, and air cushion vehicle behavior. The proposed flight is a polar orbit with migrating perigee at 120–140 km and apogee at 400–1000 km, and is planned for acquiring density measurements. The drag sensing and thrust measuring are discussed, and the design of the thrustor evaluation and calibration facility is described. It is reported that results of the control system analysis show that it is feasible to construct translation control systems for tumbling of freely spinning drag-free satellites, and that the best control mechanism is the pulse-width pulse-frequency modulation system. Effort was concentrated on obtaining quantitative experimental verification of predicted static behavior of the thin viscous film and the self-excited vertical vibrations of the gas-supported vehicle. The main results are that concave plates are most favorable. The control system simulation effort centered on leveling the granite table and surveying the table for flatness. N.E.N.

N68-11015*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ORBITS OF PHOTOGRAPHIC METEORS

Richard E. McCrosky 16 Oct. 1967 31 p refs

(NASA-CR-90249; SAO Special Rept.-252) CFSTI: HC $3.00/MF $0.65 CSCL 03A

New photographic observations of meteors in the brightness range $->M_p>-18$ (?) and with a median value of $M=-8.5$ have yielded orbits with a precision of better than 1° in the angular elements and of about 0.05 in e and 1/a. A comparison of 100 of these fireball orbits with Super-Schmidt orbits shows: (1) A class of orbits, comprising about 25% of the faint meteors, of long period is almost completely absent among the fireballs. (2) Small perihelion distances ($q<0.2$ a. u.) are not found. A maximum of $q\approx0.7$ a.u., which also appears in the Super-Schmidt orbits of short period, corresponds to the perihelion distances of all but two of the Apollo objects. (3) The distribution of aphelia shows a marked decrease at Jupiter when compared to a similar distribution of small faint-meteor orbits. With the existing material, we cannot determine whether this represents an important evolutionary distinction between meteoroids of different mass or is simply the result of an inappropriate choice of the division between "large" and "small" orbits in the faint-meteor data. Author

N68-11021# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillion-sous-Bagneux.

APPLICATION OF THE GRADIENT METHOD TO THE NUMERICAL STUDY OF LIMITED-POWER TRANSFERS BETWEEN NEAR-COPLANAR CIRCULAR ORBITS. COMPARISON WITH THE LINEARIZED SOLUTION [APPLICATION DE LA METHODE DU GRADIENT A L'ETUDE NUMBERIQUE DES TRANSFERTS A PUISSANCE LIMITEE ENTRE OTBITES CIRCULAIRES COPLANAIRES PROCHES. COMPARAISON AVEC LA SOLUTION LINEARISEE]

Herve Girard 1967 90 p refs In FRENCH; ENGLISH summary

(TN-112)

A numerical method is proposed for optimizing orbital transfer trajectories between near-coplanar circular orbits for propulsion systems of variable injection speeds and limited power. Dynamic programming, the Pontryagin principle, and the Euler–Lagrange equations are assessed as optimization methods, with the gradient method chosen for application. Calculation methods are described, and the results are compared with those obtained from analytic linearization techniques. A reference bibliography is included. Transl. by M.G.J.

N68-11033* Smithsonian Astrophysical Observatory, Cambridge, Mass.

TABLE FOR PARABOLIC ORBITS

W. P. Hirst 27 Oct. 1967 20 p

(NASA-CR-90250; SAO Special Rept.-253) CSCL 22C

A table is given for computing tan v/2 with argument $M = (t-T)/q^{3/2}$ in parabolic orbits in the solar system. The table reaches values of M greater than 10^6 and allows values of tan v/2 to be interpolated with an error not exceeding one unit in the seventh decimal place. The work was done on the CDC-6400 computer at the Smithsonian Astrophysical Observatory. Author

N68-11145*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THREE BALLISTIC CAMERA DATA REDUCTION METHODS APPLICABLE TO REENTRY EXPERIMENTS

John E. Hogge Washington Nov. 1967 42 p refs

(NASA-TN-D-4260) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Ballistic cameras were used to photograph a reentry test object against a star background in order to determine accurately the position, velocity, and deceleration of the object as it penetrates the earth's atmosphere. Three data reduction methods which are applicable to the determination of the reentry trajectories from the photographic records are discussed. One reduction method applies when the reentry image on each photographic plate can be approximated with a straight line. Another method applies when the reentry image is curved on each photographic plate. A third technique applies when the shutter of each of several cameras at different stations is synchronized in time. Author

N68-11151*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CHARACTERISTICS OF PLANETARY FLY-BY TRAJECTORIES

J. A. Behuncik Oct. 1967 42 p refs

(NASA-TM-X-63029; X-643-67-501) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Reported is a study on the phenomenon of planetary flyby and the possible free fall transfer trajectories associated with them. The analysis consists of two parts. The flyby phase consists of determining for various encounter conditions the variation of maximum changes in velocity, speed, and energy that occur during planetary flyby. The maximum change in flight path angle also is presented for each planet. The transfer phase consists of determining the transfers that emanate from earth and terminate at the circle of influence with the appropriate encounter conditions that result in a flyby with a maximum change in one of the above mentioned parameters. Time of flight and transfer angle are presented for such possible transfers. It is not possible to obtain with free fall transfers from earth the theoretically possible maximum velocity change from any of the planets except Venus and Mars. The maximum velocity change of 7.3 km/sec can be obtained from Venus with a free fall transfer of approximately 50 days duration. The heliocentric injection velocity for such transfers is in the range of from 27 to 33 km/sec. The maximum velocity change of 3.6 km/sec may be obtained from Mars with a free fall transfer of almost 145 days duration. The necessary heliocentric injection velocity at earth for such transfers is approximately 32 km/sec. Free fall transfers that derive maximum speed change from Mercury do not exist. The maximum speed change due to flyby may be obtained from Jupiter, Saturn, Uranus, Neptune, and Pluto. For example, a free fall transfer of 700 days duration may result in the maximum positive speed change of 24 km/sec from flyby of

Jupiter. The necessary heliocentric injection velocity for such a transfer, however, is close to escape velocity at one astronomical unit, i.e. ≈42 km/sec. Author

N68-11173*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN INVESTIGATION OF EARTHSHINE LIGHTING CONDITIONS FOR LUNAR-SURFACE OPERATIONS
Robert L. Jones Nov. 1967 21 p refs
(NASA-TM-X-58011) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A limited subjective investigation of the adequacy of earthshine for lunar-surface operations was conducted utilizing neutral-density filters to simulate earthshine and utilizing the MSC lunar-surface simulation as a test ground. The lighting conditions were considered to be good if the test subjects indicated, subjectively, a sense of confidence in their ability to traverse the rougher portions of the simulation and if they were able to distinguish the relief of distant features such as craters. It was assumed that an auxiliary light would be available to illuminate shadowed areas. Although the earthshine evaluation was quite subjective and limited in the amount of test data collected, the results indicated that under certain conditions earthshine is adequate for lunar operations. The results further indicated that as the landing-site arc distance from the mean libration point increases, the number of days of suitable lighting rapidly decreases. Only landing sites near the center of the lunar disk appear to afford suitable lighting conditions throughout the lunar night. Author

N68-11207*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPLICIT UPPER BOUNDS FOR ERROR PROPAGATION IN THE n-BODY FIELD
Albert Rosen Nov. 1967 27 p refs
(NASA-TM-X-63035; X-641-67-579) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A simple means for bounding the propagated trajectory error induced by an impulsive initial error in the n-body field is developed. Formulas are derived for the maximum acceptable initial error, given the mission tolerances, and for the maximum time of negligible propagated error, given the initial impulses and mission tolerances. An example illustrates the use of the results within the Solar System. Author

N68-11280*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMPROVEMENT OF MEAN ORBITAL ELEMENTS FOR VINTI'S SPHEROIDAL SATELLITE THEORY
Harvey Walden Sep. 1967 18 p refs
(NASA-TM-X-63028; X-553-67-462) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A method is proposed for improving the set of mean orbital elements for Vinti's spheroidal satellite theory in the absence of observational data, i.e., when the usual differential method of orbit improvement by a least-squares process is unavailable. An iterative procedure involving the first-order Taylor's series expansion of position and velocity residuals at epoch time is utilized. This process may be used to determine mean orbital elements directly from initial conditions or Keplerian osculating elements, thus eliminating the need for numerical factorization of two quartic polynomials arising in the inversion of the integrals of motion. Alternatively, the method may be applied to find the small corrections to the mean orbital elements following numerical factorization of the quartics, as carried through second order in the oblateness parameter by Vinti. Numerical results are presented indicating both aforementioned applications of the method to actual satellite trajectories. Author

N68-11295*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD RESTRAINTS FOR SPACECRAFT SYSTEMS AND SUBSYSTEMS
Charles A. Harris Feb. 1967 94 p refs
(NASA-TM-X-55790; X-325-67-70) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Methods for limiting the magnetic fields generated by spacecraft systems and subsystems, are discussed in this report. Accepted practices useful in the design and fabrication of spacecraft systems, actual data related to the fields generated by individual components, and specific examples of field reduction techniques are furnished. Author

N68-11315* Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A. VOLUME 4, SECTION 4: SYSTEMS INTEGRATION Final Technical Report
18 Oct. 1967 318 p
(Contract NAS8-20256)
(NASA-CR-90299) CFSTI: $3.00 CSCL 22A

Systems integration are detailed for the optical technology development program of the Apollo extension system. Eight feasible missions that allow for experiment growth were defined for which 12 spacecraft were identified along with combinations of four launch vehicles. These vehicles include the presently funded Saturn V and Atlas/Centaur. After the first few days of a space mission, the projected experiments will be able to be performed on demand with the timeline serving as a needed reference and with experiments assigned to all four sections of the divided day. The fine guidance telescope can be used for astronomical purposes during the unmanned portion of the space flight. Details are included for the baseline mission, spacecraft environment, reliability models and predictions, and ground stations. M.W.R.

N68-11316*# Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A, VOLUME III, SECTION III: EXPERIMENTS Final Technical Report
18 Oct. 1967 308 p refs
(Contract NAS8-20256)
(NASA-CR-90303) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Justification, operational procedures, and supporting analyses are presented for stellar oriented and large optics experiments in connection with the optical technology development for the Apollo extension system. The former includes fine guidance and isolation experiments; and the latter discusses primary mirror configuration alternatives, thin mirror nesting experiment, and primary figure test and correction experiment procedure. Integrated experiment requirements are outlined, as are experiments that were discarded, new experiments, and operational uses of the optical technology for the Apollo extension system. M.W.R.

N68-11317* Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM, PHASE A. VOLUME 1, SECTION 1 AND 2: PROGRAM RESULTS AND OPTICAL TECHNOLOGY DEVELOPMENT PLAN Final Technical Report
24 Oct. 1967 138 p
(Contract NAS8-20256)
(NASA-CR-90298) CFSTI: $3.00 CSCL 22A

Program results and the optical technology development plan are summarized for the Apollo extension system program. While some of the technology problems can be solved through a ground program of research and development, it is concluded that space experiments are required for full development and evaluation of alternative solutions. Application areas considered deal with astronomy, remote sensing, meteorology, and optical communications; and technology programs are concerned with detectors, optical

components and communication, guidance and isolation, human factors, and environmental effects. A comprehensive plan for incorporating all of these efforts is detailed. M.W.R.

N68-11345* Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM. PHASE A: EXECUTIVE SUMMARY
18 Oct. 1967 27 p
(Contract NAS8-20256)
(NASA-CR-90297) CFSTI: $3.00 CSCL 22A

Development of space optics through experimentation in astronomy, earth observations, communications, and meteorology is described as the primary purpose of Optical Technology Apollo Extension System. Its 13 basic experiments fall into three groups: optical propagation, large optics, and stellar oriented study. The experiments briefly discussed are: optical heterodyne detection on earth and in space, direct detection on earth, megahertz optical communication, precision tracking of a ground beacon, 10μ phase and amplitude correlation, pulse distortion measurements, primary mirror figure test and correction, thin mirror nesting principle, fine guidance, and comparison of isolation techniques. In addition, manning, mission constraints, and candidate subsystems are discussed. S.P.

N68-11369*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVESTIGATIONS IN HANSEN'S PLANETARY THEORY
Peter Musen Washington Nov. 1967 24 p refs
(NASA-TN-D-4169) CFSTI: HC $3.00/MF $0.65 CSCL 03C

The geometrical characteristics of Hansen's planetary theory favor the expansion of perturbations in terms of the disturbed mean anomalies of the auxiliary planets. This eliminates the need to expand the disturbing force and speeds up the convergence of series representing Hansen's coordinates. An economy is achieved on the expansions of odd negative power of the mutual distances. There is no need to form the derivatives of the first and higher orders of the disturbing function relative to the pseudo-time. Hansen's theory is more intimately connected with perturbations in the rectangular coordinates than with perturbations of the elements. For this reason, direct use is made of the differential equations of motion in rectangular coordinates relative to an inertial frame of reference. Hansen had to introduce the perturbations of the third coordinate by combining the direct kinematical considerations with the method of variation of constants. Hansen's W-function is not used because of the way the operations with periodic series are performed on electronic machines. However, the $\overline{W}$-function is retained because it is intimately connected with determining perturbations in the mean anomaly and with forming the integrating operators. R.N.A.

N68-11406* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL DEVELOPMENT EPHEMERIS NUMBER 19
Charles J. Devine 15 Nov. 1967 91 p refs
(Contract NAS7-100)
(NASA-CR-90422; JPL-TR-32-1181) CSCL 03B

The second issue of JPL Ephemeris Tapes is described, and is designated JPL Development Ephemeris No. 19 (DE19). These tapes carry the positions and velocities of the planets and of the moon, nutations and nutation rates in longitude and obliquity for the moon, and second and fourth modified differences of all these quantities for the interval from December 30, 1949 to January 5, 2000. The description includes the improvements in the Lunar Ephemeris and the planetary ephemerides made subsequently to the first issue of the JPL Ephemeris Tapes (DE3). Author

N68-11424# RAND Corp., Santa Monica, Calif.
MICROMETRIC MEASUREMENTS OF VENUS DURING 1964–1966
S. M. Olenicoff Oct. 1967 12 p ref Transl. into ENGLISH from Astron. Vestn. (Moscow), v. 1, no. 2, Apr.–Jun. 1967 p 121–123
(P-3692; AD-659727)

Results are presented of micrometric measurements of a lengthening of the horns of the crescent of Venus, her phases, and the determination of the instant of dichotomy, carried out with the 30-centimeter refractor of the Volgograd Planetarium observatory. Author (TAB)

N68-11456*# National Aeronautics and Space Administration, Washington, D. C.
INTERSTELLAR GRAINS
J. Mayo Greenberg, ed. and T. P. Roark, ed. 1967 275 p refs Presented at Rensselaer Polytech. Inst., Troy, N. Y., 24–26 Aug. 1965
(NASA-SP-140) GPO: $1.25 CSCL 03B

Conference papers on observational and theoretical interpretations of interstellar grains are presented. The principal issues are identified as being the following: uniformity of the ratio of total to selective extinction; dielectric grains versus graphite or graphite core plus dielectric mantle grains; variations of the reddening law and of the wavelength dependence of polarization and their respective relations with localized phenomena and the problems of galactic structure; formation of interstellar molecules, mainly OH and H_2; diffuse interstellar lines; and the physics and chemistry of grain nucleation and growth. Discussions following the papers are also included. N.E.N.

N68-11594*# California Univ., Berkeley. Space Sciences Lab.
MARS: VISIBLE AND NEAR INFRARED STUDIES AND THE COMPOSITION OF THE SURFACE
Brian T. O'Leary (Ph.D. Thesis) 8 Nov. 1967 186 p refs *Its* Space Sci. Lab. Ser. 8, Issue 103
(Grant NsG-101-61)
(NASA-CR-90495) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Polarimetric, photometric, and spectrophotometric measurements of Mars are analyzed, and observational and experimental data on the composition of the Martian surface are presented. Two fundamental optical parameters are considered: polarization vs. phase angle at all angles, and reflectivity vs. phase near opposition where the shape and extent of the brightness surge when Mars approaches very small phase angles. Photometric observations of Mars in six colors are described; these indicate a moderate opposition effect for Mars, but much less pronounced than the lunar opposition effect. Visible and near infrared spectrophotometry techniques and a specially designed reflectometer–polarimeter were used to measure the opposition effects and phase functions of various sample substances of interest for the Martian surface. It is concluded that although the limonite, goethite, and hematite samples match the Martian opposition effects reasonably well, the lack of 0.87-μ iron oxide band in the Martian spectrum makes if very difficult to explain any of these samples as the predominant surface substance on Mars. M.G.J.

N68-11595* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NEWTONIAN PLANETARY EPHEMERIDES 1800–2000: DEVELOPMENT EPHEMERIS NUMBER 28
Jay H. Lieske 15 Nov. 1967 77 p refs
(Contract NAS7-100)
(NASA-CR-90430; JPL-TR-32-1206) CSCL 03A

Dynamically consistent Newtonian ephemerides of the nine principal planets have been generated from 1800–2000 with epoch 1899 December 12, 0^h ET (Julian Ephemeris Date 241 5000.5). The fifty-fourth order set of differential equations determining the motion of the nine planets is solved by numerical methods and the integrated ephemerides are adjusted to make a best fit in the least squares sense to suitably modified classical source ephemerides. Secular deficiencies in the Newtonian modified source ephemerides are determined and analyzed. Author

N68-11628*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESONANT GRAVITY HARMONICS FROM 3-1/2 YEARS OF TRACKING DATA ON THREE 24 HOUR SATELLITES

Carl A. Wagner Nov. 1967 49 p refs

(NASA-TM-X-63041; X-643-67-535) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Over 500 orbits of the synchronous satellites Syncom 2, Syncom 3 and "Early Bird" have been examined to reveal the long term effects of the longitude dependence of the earth's gravitational field. The period of record extends from August 1963 to January 1967. The east–west drift of these synchronous orbits are strongly influenced by the low order gravity harmonics H_{22} and H_{33} which are in resonance with them. The bounds on these harmonic parameters are felt to be quite conservative and reflect likely effects of higher order resonant gravity harmonics which could not be well determined by the data. The full record through January 1967 now permits the discrimination of the long term east–west drift acceleration of a geostationary satellite to within 5.5×10^{-5} deg/day^2 (Maximum 1σ) around the equator. Author

N68-11630*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex..

AN EVALUATION OF THE THERMALLY RADIANT ENVIRONS OF A MAN ON THE LUNAR SURFACE

David H. Perel and Alan J. Chapman Washington Nov. 1967 72 p refs

(NASA-TN-D-4243) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Analytical methods were developed for determining the quantities of radiative thermal energy to provide a quantitative evaluation of the effects of the lunar thermal environment on a pressure-suited man. Evaluations were limited to lunar plains. A multicylinder man and a hemisphere-cylinder man were considered in the analysis. While emphasis was placed on the evaluation of quantities of thermal radiation from the lighted side of the moon, the radiation on the dark portion was also considered and illustrated. The results of the investigation are presented in parametric form to allow the solution of specific problems over a wide range of variables. Author

N68-11635# Osservatorio Astrofisico, Asiago (Italy).

LUMINOSITY DISTRIBUTION IN NGC 4618-25

Francesco Bertola Repr. from Mem. Soc. Astron. Italiana (Italy), v. 38, no. 2, 1967 10 p refs *Its* Contrib. No. 197

CFSTI: HC $3.00/MF $0.65

The late-type barred spirals NGC 4618 and NGC 4625, which constitute a system having some resemblance with the Magellanic Clouds, have been investigated by means of photographic photometry. The luminosity profiles in the outer parts are characterized by straight line decay, typical of the disk component, except the NE side in NGC 4625, where the decline resembles that of the bulge component. The total B magnitudes are 11.50 and 12.90 for NGC 4618 and NGC 4625 respectively. The corresponding absolute magnitudes, corrected for galactic absorption, are −17.75 and −16.35, adopting m-M=29.0. The pronounced asymmetry of these one-armed spirals does not allow a precise determination of the tilt angle. The luminosity distribution in NGC 4618-25 is rather similar to that of the Magellanic Clouds, although the latter are of more advanced morphological type. Author

N68-11652* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ROCKET ULTRAVIOLET SPECTROPHOTOMETRY IN THE ORION REGION

Albert Boggess, III and Yoji Kondo Nov. 1967 10 p refs

(NASA-TM-X-63044; X-613-67-565) CFSTI: $3.00 CSCL 03B

Low resolution ultraviolet spectra of several bright stars in the region of Orion were photographed from an Aerobee rocket to obtain objectively dispersed spectrograms suitable for relative spectrophotometry of early type stars. The results for those stars for which the data is most reliable are tabulated. The wavelengths 1750, 2250, and 2750 Å were chosen as representative, and the stellar brightnesses average over 100 Å intervals are given relative to the brightness of α Canis Majoris. The data are estimated to be good to one-tenth magnitude. Also included are an ultraviolet spectrogram and detailed plots of ultraviolet spectral energy distributions. R.N.A.

N68-11699# Osservatorio Astrofisico, Asiago (Italy).

MASS AND LUMINOSITY DISTRIBUTION IN GALAXIES NGC 5005 AND NGC 6503

Francesco Bertola and Pier Luigi Bernacca Repr. from Mem. Soc. Astron. Italiana (Italy), v. 38, no. 1, 1967 12 p refs *Its* Contrib. No. 194

CFSTI: HC $3.00/MF $0.65

The light distribution in the Sb galaxy NGC 5005 and in the Sc NGC 6503 has been investigated by means of the photographic photometry. Isophotes, luminosity profiles, relative integrated luminosity curves, equivalent luminosity profiles and total magnitudes have been derived. The light distribution is compared with the mass distribution obtained by other authors. The mass to light ratio, considered as a function of the distance from the center, decreases slowly outward in the outer regions of NGC 5005, while it decreases with steep gradient in NGC 6503. A parallelism between the trend of M/L and of the color is observed. It is suggested that the ordering of galaxies according to their M/L and color gradients could constitute a sequence having significance with respect to the way in which a galaxy was formed and evolved. Author

N68-11716# Padua Univ. (Italy). Astrophysical Observatory.

SPECTRAL CLASSIFICATION WITH OBJECTIVE PRISM OF THE STARS IN THE ORION COMPLEX [CLASSIFICAZIONE SPETTRALE CON PRISMA OBIETTIVO DI STELLE DEL COMPLESSO ORIONE]

Pier Luigi Bernacca 1967 14 p refs Repr. from Mem. Soc. Astronomica Ital. (Italy), v. 38, no. 1, 1967 In ITALIAN; ENGLISH summary *Its* Contrib. No. 195

CFSTI: HC $3.00/MF $0.65

Spectra of 197 stars in or near the Orion Nebula have been classified from plates taken with the 12° objective prism applied to the 40–50–100 cm Schmidt telescope of the Astrophysical Observatory of Asiago. The dispersion is about 450 A/mm at Hγ. The two stars P1259 and P2674 are suspected to be metallic lines stars. By comparing the spectral type derived from the lines with that derived through the Q parameter by Sharpless (1954), twelve stars have been selected which show an ultraviolet excess of the order of $0^m.4$. Author

N68-11717# Padua Univ. (Italy). Astrophysical Observatory.

VARIABLE STARS OF THE GLOBULAR CLUSTER NGC-5024 (M 53). 3: PERIOD VARIATION, PHOTOMETRIC CHARACTERISTICS, AND POSITION ON H-R DIAGRAMS OF RR LYRAE VARIABLES [LE STELLE VARIABILI DELL'AMMASSO GLOBULARE NGC 5024 = M 53. 3: VARIAZIONI DI PERIODA, CARATTERISTICHE FOTOMETRICHE E POSIZIONE SUL DIAGRAMMA H-R DELLE VARIABILI RR LYRAE]

Rino Margoni 1967 30 p refs In ITALIAN; ENGLISH summary *Its* Contrib. No. 198

CFSTI: HC $3.00/MF $0.65

The photographic material collected between 1961 and 1966 with the 122 cm reflector of Asiago and the maxima determined by A. A. Wachmann (1965) for the years 1944 to 1955 have been combined in a study of the period variation and other properties of variable stars in M 53. Plates obtained at Asiago in 1964–1966 of 33 RR-Lyrae stars have yielded the position of variables on the V, P-V diagram of Cuffey (1957). Recent

observations on 1966 have further improved and confirmed the results presented at the 3rd Variable Stars Colloquium at Bamberg (1965). Author

N68-11784*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A GENERAL ANALYTICAL METHOD FOR ARTIFICIAL-SATELLITE LIFETIME DETERMINATION
Frank Garcia, Jr. Dec. 1967 27 p refs
(NASA-TN-D-4281) CFSTI: HC$3.00/MF$0.65 CSCL 22A

An expression for obtaining the lifetimes of artificial satellites in circular orbits is developed. A complete derivation of the method is presented to allow the user to evaluate its assumptions according to specific needs. The accuracy of the developed method is verified using Earth and Mars as examples and comparing the results to the results obtained from numerically integrated and approximate analytical trajectories. Characteristic altitude histories are presented for the trajectory methods and the described analytical solution. Expressions for computing lifetimes of elliptical orbits are also included, with the necessary graphical presentations to provide rapid solution of these expressions. Author

N68-11762# Osservatorio Astrofisico, Asiago (Italy).
THE SINGLE-LINE ECLIPSING BINARY BV 267
A. Mammano, R. Margoni, and M. Perinotto 1967 14 p refs *Its* Contrib. No. 192
CFSTI: HC$3.00/MF$0.65

The elements of the spectroscopic orbit of the single-line eclipsing binary BV 267 are calculated. The absolute properties of the system are also deduced by assuming that the primary conforms to Kopal's (1959) mass-luminosity relation for detached systems, and by combining the spectroscopic elements with the photometric ones given by Kondo (1966). The secondary should appear as a subgiant nearly in contact with its Roche lobe and smaller than the companion. The hypothesis advanced by Roxburgh (1966) for the similar system KO Aql is examined. The contraction times of its components are of the same order of magnitude. Also the angular momentum of BV 267 agrees with that expected according to Roxburgh's fission theory (1965) for the parent star. Among 58 detached and semidetached systems, only KO Aql and BV 267 exhibit such accord. The possibility that BV 267 is contracting after fission is not in contradiction with the probability of detecting a star 10^8 years old. However, we cannot dismiss the possibility that the present secondary was originally the more massive component, and has lost matter to its companion. Author

N68-11774# Air Force Cambridge Research Labs., Bedford, Mass.
RADIOMETRIC OBSERVATIONS OF THE PLANETS JUPITER, VENUS, AND MARS AT A WAVELENGTH OF 8.6 MILLIMETERS
P. M. Kalaghan and K. N. Wulfsberg Jul. 1967 17 p refs *Its* Environ. Res. Paper No. 270
(AFCRL-67-0409; AD-659744)

Observations of the 8.6 mm radio emission from the planets Jupiter, Venus, and Mars are reported. Average disc temperatures of 140 (+18, -14)K for Jupiter, 423 (+55, -34)K for Venus over the 51 degrees to 62 degrees phase angle range, and 235 (+45, -33)K for Mars were obtained. Author (TAB)

N68-11786# Padua Univ. (Italy). Astrophysical Observatory.
RESEARCH WITH THE ASIAGO 40 CM SCHMIDT TELESCOPE. 1: STUDY OF THE VARIABLE STARS IN THE FIELD AROUND RHO CYGNI [RICERCHE COL TELESCOPIO SCHMIDT DI 40 CM DI ASIAGO. 1: STUDIO DELLE STELLE VARIABILI DEL CAMPO ATTORNO A RHO CYGNI]
Giuliano Romano 1967 34 p refs Repr. from Mem. Soc. Astron. Ital. (Italy), v. 38, no. 1, 1967 In ITALIAN; ENGLISH summary *Its* Contrib. No. 193

This paper gives the results of the photographic study of 74 variable stars of the field around Cygni on material obtained with the Schmidt telescope (40/50/100) of Asiago. Eight new variable stars have been discovered. Positions and characteristics of the variables are tabulated. Author

N68-11793 Adelaide Univ. (Australia).
THE VARIABILITY OF CENTAURUS XR-2
R. J. Francey (Tasmania Univ.), A. G. Fenton (Tasmania Univ.), J. R. Harries, and K. G. McCracken May 1967 12 p refs

The changes in the X-ray flux from the Centaurus XR-2 object which occurred during the period April–May, 1967 are presented in detail. It is shown that during that time the X-ray energy output decreased approximately exponentially as a function of time, with a time constant of 25-days. C.T.C.

N68-11799 Osservatorio Astrofisico, Asiago (Italy).
ON THE VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 7006
L. Rosino and F. Ciatti 1967 32 p refs *Its* Contrib. No. 199

The variable stars in the remote globular cluster NGC 7006 have been examined on Mt. Wilson, Asiago and Palomar plates obtained from 1931 to 1958. Table II gives the results. The cluster belongs to Oosterhoff's type I, its RR Lyrae-*a* variables having a mean period $P = 0^d.564$. Their mean median magnitudes are: $\bar{m}_p = 19.03$; $B = 19.18$; $V = 18.84$. The individual median color indices $B-V$ fall between +0.24 and +0.45; $B-V = 0.345$. Assuming for the RR Lyrae a mean median absolute magnitude $M_v = +0.5$, the uncorrected distance modulus is $m-M = 18.34$ and the distance 46.6 Kpc. Light curves are given for 27 RR Lyrae variables and one semiregular. Twenty-one new variable stars (No. 55-75) have been found and reported in Table III. Author

N68-11802*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES OF REFLECTION CHARACTERISTICS OF THE PLANET EARTH FROM A SYNCHRONOUS SATELLITE—PRELIMINARY RESULTS
Ehrhard Raschke and William R. Bandeen Nov. 1967 16 p refs
(NASA-TM-X-63045; X-622-67-572) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Digitized data of nine ATS-1 photographs taken on 21 and 22 April 1967 were used to study statistically the dependence of reflection properties of the earth-atmosphere system on the zenith and azimuthal angles of measurement and on the zenith angle of incident solar radiation. Four states of the sky were defined for this study: complete overcast, cloudy-overcast, cloudless atmosphere, and minimal reflection. The limited quantity of data analyzed so far provides sufficiently accurate results only for small solar zenith angles ($0.0° \leq \zeta \leq 25.8°$). A remarkably high reflection was found in

all conditions in a small angular range around the specular point of the sun on the earth's surface. The horizon appeared to be brighter than other areas for cloudless atmosphere conditions only. A maximum of reflected solar radiation due to direct backscattering was not found in these preliminary results. Author

N68-11821*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVESTIGATION OF POSSIBLE ABUNDANCE ANOMALIES IN CLOSE BINARIES OF SPECTRAL TYPES A0–A2 AND F5–F6 (4–5)
Yoji Kondo (Kitt Peak Natl. Obs.) Nov. 1967 8 p refs Presented at 13 Gen. Assembly of the IAU, Aug. 1967
(NASA-TM-X-63042; X-613-67-544) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Eleven close spectroscopic binaries in the spectral regions A0–A2 and F5–F6 (IV–V) were observed with dispersion of 13.5 A/mm at the Coude focus of the 84-inch reflector of the Kitt Peak National Observatory. The program was originally intended as an extension of a work by Abt (1965). Preliminary analysis shows the following results. The spectra of both components of a double line system 50 Dra show metallicity. HR 5317, which is classified as middle F type, shows characteristics of a metallic-line star, and another middle F type system HR 4536 shows similar spectral characteristics to a lesser extent. An apparent over-abundance of Ca was found for HR 5317 and HR 4536. Nine out of eleven close binaries observed show metallicity. When metallicity is observed, it appears to be more enhanced for a shorter period, though a generalization is not possible with the number of stars observed in this work. Author

N68-11840*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
OPTIMAL MULTIPLE-IMPULSE ORBITAL RENDEZVOUS
John E. Prussing (Ph.D. Thesis) Aug. 1967 145 p refs
(Grant NSG-254-62)
(NASA-CR-90536; TE-20) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Minimum-fuel, multiple impulse orbital rendezvous is investigated for the case in which the transfer time is specified (time-fixed case). A method for obtaining optimal solutions is presented which is applicable to transfers between elliptical orbits of low eccentricity. In this method optimal solutions are constructed by satisfying the necessary conditions for the primer vector. It is assumed that the terminal orbits lie close enough to each other that the linearized equations of motion can be used to describe the transfer. The boundary value problem for the rendezvous is then solved analytically. A complete solution to a specific class of rendezvous problems is obtained for a range of transfer times. The specific case considered is multiple-impulse rendezvous between coplanar circular orbits. Two-, three-, and four-impulse transfers are minimizing solutions for this problem. Since the transfer time is fixed, a coasting period in the initial or final orbit is optimal for certain rendezvous situations. Author

N68-11841*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 1: PROGRAM DESCRIPTIONS FOR INTERPLANETARY FREEFALL TRAJECTORIES
[1967] 103 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This document contains the description of the digital simulations for the generation of nominal interplanetary free-fall trajectories. It is organized in three parts. Part 1-1 and Part 1-2 contain the description of two computer decks for heliocentric and planetocentric phases, respectively. Part 1-3 gives an outline of how these programs can be used for the design of interplanetary free-fall mission profiles. Author

N68-11843*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTION. PART 3: NOMINAL POWERED FLIGHT TRAJECTORIES
[1966] 278 p ref
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The purpose of this document is to describe the booster program 118.0 and provide a guide for an engineer to use in running the program. Program 118.0 was initially written for simulation of various vehicles from launch at the earth's surface into various orbits. It is a complex but flexible program and is adaptable for simulating space boost missions. Seven specific missions that have been generated on this program are provided as examples in Section 5, the User's Guide. Author

N68-11845*# General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEMS REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 5: NOMINAL ATMOSPHERIC ENTRY TRAJECTORIES, VERSION 1
31 Jul. 1966 127 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 5) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The computer program defined by this document is designed to simulate the flight of a lifting vehicle during atmospheric entry. Single pass as well as single skipout trajectories can be simulated. It also forms the basis of the nominal and actual trajectory block as used in the performance assessment program for aided-inertial entry guidance systems. Author

N68-11846* General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 6: NOMINAL ATMOSPHERIC ENTRY TRAJECTORIES, VERSION 2
31 Aug. 1966 154 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 6) CFSTI: $3.00 CSCL 22C

This document describes a digital computer program developed to simulate single-pass and single-skipout trajectories for a lifting-type vehicle during atmospheric entry. The description includes a mathematical model, a computer program description, a user's guide, an operator's and programmer's guide, a test case, and a program listing. The mathematical model describes the equations used in generating the trajectory. The computer program description includes the flow charts and detailed equations on which the development of the computer program was based. The user's guide includes explanations of various input quantities. Some of these input quantities provide capabilities not incorporated in Version I, including variation of the angle of attack, a new control law for

portions of "constant altitude flight phases," graphic output, automatic corridor boundary definition, and output of magnetic tape for a Performance Assessment Program. The operator's and programmer's guide and the listing provide detailed information about the program and the system for which it is designed. The program was written in FORTRAN IV for the IBM 7094 or the IBM 7040. Author

N68-11848* General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 8: PROGRAM DESCRIPTION FOR MATCHED INTERPLANETARY FREE-FALL TRAJECTORIES
[1967] 178 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 8) CFSTI: $3.00 CSCL 22C

This document contains a detailed description of a double-precision digital computer program for the computation of parameters and initial conditions of matched heliocentric and planetocentric phases of interplanetary trajectories. Included are descriptions of the mathematical model, detailed equations and logic flow, program usage, a sample case, and program listing. Author

N68-11849* General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 9: PROGRAM DESCRIPTION FOR OPTIMUM LOW THRUST TRAJECTORIES
[1967] 38 p ref
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 9) CFSTI: $3.00 CSCL 22C

This document describes a computer program which generates low thrust interplanetary trajectories assuming constant and continuous thrust from given initial and final position, velocity, and time of flight. An iteration process is used in which the thrust magnitude is a variable parameter. Author

N68-11850* General Motors Corp., El Segundo, Calif. AC Electronics Div.
INTERPLANETARY GUIDANCE SYSTEM REQUIREMENTS STUDY. VOLUME 2: COMPUTER PROGRAM DESCRIPTIONS. PART 10: PROGRAM DESCRIPTION FOR PERFORMANCE ASSESSMENT OF LOW THRUST SPACE GUIDANCE SYSTEMS, VERSION 1
[1967] 37 p refs
(Contract NAS12-7)
(NASA-CR-86009, V. 2, Pt. 10) CFSTI: $3.00 CSCL 22C

This report contains descriptions of a mathematical model and computer simulation program developed to study aided inertial navigation for low thrust spacecraft, both for heliocentric transfer and planetocentric spiral. The simulation program provides nominal mission profiles with corresponding statistical quantities, with graphs of these also. Studies of sensitivity to errors in the a priori statistics are also performed. Author

N68-11858*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A STUDY ON GAS MOLECULE–SOLID SURFACE INTERACTION SATELLITE EXPERIMENT FEASIBILITY Final Report
K. M. Foreman and R. A. Oman Aug. 1967 51 p refs
(Contract NAS8-21090)
(NASA-CR-90527; RE-301) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The feasibility of conducting two types of experiments in an earth satellite is examined. The primary point of view is the ability to determine the angular distribution of reflected gas molecule density, momentum, and energy accommodation. The engineering need and feasibility are established for experiments designed to examine the changes in solid surface properties arising from exposure to the natural environment. Surface condition is considered a vital factor in rarefied gas interaction processes. A satellite-borne experiment of the molecular beam scattering type cannot be considered feasible until a suitable technique is demonstrated for measuring the velocity of reflected molecules at orbital conditions. Measurement of molecular density distribution appears feasible within current technology. An examination is made of recent data on profiles of atmospheric density and its influence on the design of a mission plan. A nominal orbit of 240 km initial perigee with 1.5% to 3.5% eccentricity is indicated. An experiment package concept is presented, and recommendations are made for a four part development program. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-11047*# National Aeronautics and Space Administration, Washington, D. C.
APOLLO 4 SPACECRAFT PERFORMANCE
3 Dec. 1967 8 p
(NASA News Release-67-294) Available from the Scientific and Technical Information Division CSCL 22B

A preliminary evaluation of Apollo 4 mission performance is presented in a news release. Systems analysis thus far indicates all specifications were carried out satisfactorily. Statements on systems performance are supplemented by a detailed chronological listing of major spacecraft events from the first SPS ignition through landing. E.C.

N68-11048*# National Aeronautics and Space Administration, Washington, D. C.
PIONEER C LAUNCH
6 Dec. 1966 8 p
(NASA News Release-67-293) Available from the Scientific and Technical Information Div. CSCL 22B

Mission objectives for the Pioneer C launch are reported in a news release. Planned experiments involving investigation of the earth's magnetosphere and the monitoring of solar events are briefly described. The achievements of past Pioneer flights are mentioned. E.C.

N68-11100* Chrysler Corp., New Orleans, La. Space Div.
OPTICAL TECHNICAL APOLLO EXTENSION SYSTEM, PHASE A, VOLUME 5. SECTION 5: SUBSYSTEM DESIGN Final Technical Report
18 Oct. 1967 352 p
(Contract NAS8-20256)
(NASA-CR-90304) CFSTI: $3.00 CSCL 22B

The function of the Phase A design integration task consists of three functions: a. The conceptualization of promising spacecraft designs which satisfy selected alternative missions and a specific program alternative; b. The development and control of the Optical Technology Apollo Extension System Subsystem Requirements Digest which is configured to provide an up-to-date information distribution system on spacecraft subsystems and their requirements;

and c. The layout and design of selected conceptual spacecraft designs into feasible systems consistent with all missions, experiments, systems, and subsystem requirements. Author

N68-11192*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SIMULATION TEST REPORT FOR THE S-IVB ORBITAL WORKSHOP CREW QUARTERS FLOOR AND WALL GRIDS
23 Oct. 1967 28 p
(NASA-TM-X-53667) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Ease of movement across two simulated S-IVB orbital workshop crew quarters floor and wall grid configurations (with either 0.08 or 0.15 meter triangular grid openings) was compared. Evaluation tests were conducted in a zero-g engineering mock-up. Test subjects moved across the grid configurations in SCUBA gear and Mark IV pressure suits with thermal gloves. It was concluded that the 0.15 meter grid design was preferable, providing a better grid handgripping capability. E.C.

N68-11368*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TERMINAL STERILIZATION PROCESS CALCULATION FOR SPACECRAFT
A. R. Hoffman and J. A. Stern 15 Nov. 1967 16 p refs
(Contract NAS7-100)
(NASA-CR-90424; JPL-TR-32-1209) CFSTI: HC $3.00/MF $0.65 CSCL 22B

To satisfy the planetary quarantine requirement, a dry heat thermal sterilization process may be applied to a planetary spacecraft prior to launch. Because of the complexity of the vehicle, it is important that the terminal process be the minimum necessary to assure that the desired sterility has been attained so as to maximize the reliability of both the spacecraft and the mission. Analytical studies have been performed for the purpose of identifying various facets of the process. A mathematical model was constructed. The model was based on a simple geometrical configuration and assumed a logarithmic survival of microorganisms. Various aspects that influence the thermal process parameters of time and temperature were studied. It was shown that transient lethality—that is, lethality during heat up and cool down—may significantly influence the time required at sterilization temperatures. Author

N68-11476*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SIMULATOR STUDY OF PILOT CONTROL OF REMOTE ORBITAL DOCKING OF LARGE ATTITUDE-STABILIZED COMPONENTS
Donald R. Riley and William T. Suit Washington Dec. 1967 22 p refs
(NASA-TN-D-4263) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A brief fixed-base-simulator study has been made to determine the ability of human pilots to perform orbital docking between two spherical tanks from a manned spacecraft positioned some distance away. All three vehicles were assumed attitude stabilized. The pilot was given translational control of the manned spacecraft and of one of the remotely located tanks by means of simple on–off reaction jets. Guidance cues were obtained from two light spots, displayed on a cylindrical screen, that symbolized the two fully illuminated spherical tanks. In the simulator, docking was considered complete when the two light spots were the same size and were positioned tangent to each other directly ahead of the pilot. The results of the investigation indicated that pilots could complete remote docking with acceptable terminal conditions except for longitudinal positioning. An upper limit to the energy exchange between tanks at contact was shown by the data for the three velocity components between tanks which were found to be of small magnitude and invariant with spacecraft range. Data on the longitudinal misalinement between tanks, however, indicated that, as range of the manned spacecraft was increased above a given value, docking success decreased. Author

N68-11520*# North American Aviation, Inc., Downey, Calif.
INFLUENCE OF STRUCTURE AND MATERIAL RESEARCH ON ADVANCED LAUNCH SYSTEMS' WEIGHT, PERFORMANCE, AND COST Summary Report, May 25, 1965–Jun. 30, 1967
J. A. Boddy and J. C. Mitchell Washington NASA Dec. 1967 61 p refs
(Contract NAS7-368)
(NASA-CR-974; SID-67-542-1) CFSTI: HC $3.00/MF $0.65 CSCL 22D

This report summarizes results of a two-phase study effort completed under a program focusing on the development of programmed assistance in directing structures research. Phase I of this program involved modifying and utilizing existing automated analytical techniques to determine significant structures and materials research areas in current and predicted future expendable launch vehicle systems. The Phase I study covers the parametric synthesis of expendable launch vehicles and a more detailed design synthesis of some of the structural components of these vehicle systems. A definition of the vehicle systems and structural synthesis of Phase I is also summarized. The Phase II effort was an extension of the design synthesis to advanced structural concepts, application to the base-line vehicle systems of Phase I and the evaluation of the relative merits to provide direction for worthwhile areas for structures and material research. Parametric vehicle synthesis was further adapted to encompass vehicle systems with recoverable first stages. The recoverable stages considered were expendable stages with recoverable features, i.e., winged body shapes with flyback propulsion and landing provisions. Author

N68-11593# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET ADD-VB-10 LAUNCHED AT CHURCHILL RESEARCH RANGE 4 MAY 1967
Oct. 1967 29 p refs *Its* Operation Requirement No. 254
(SRFB-007) CFSTI: HC $3.00/MF $0.65

This report deals with the engineering aspects of preparing the payload and the launching of Black Brant rocket ADD-VB-10 at Churchill Research Range on 4 May 1967. The primary objectives were: the measurement of vertical temperature distribution during an auroral disturbance at night, to measure atmospheric characteristics at heights much greater than that of the aurora, and to detect the presence of alpha particle radiation. The following experiments were also included: extending, ejectable and planar plasma probes, soft electron spectrometer, a photoionization chamber and a photometer. Experiments were supplied by the University of Saskatchewan, Defence Research Telecommunications Establishment and the Upper Atmosphere Research and Cosmic Ray Sections of the National Research Council of Canada. Author

N68-11607*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETERMINATION OF FOOTPAD PENETRATION DEPTH FROM SURVEYOR SPACECRAFT SHADOWS
R. L. Spencer 15 Oct. 1967 32 p refs
(Contract NAS7-100)
(NASA-CR-90512; JPL-TR-32-1180) CFSTI: $3.00 CSCL 22B

A simple form of optical triangulation, suing the *Surveyor* TV camera view angles and sun shadows, is used to determine the elevation of the lunar surface relative to the *Surveyor* spacecraft. A group of these elevation points, near the spacecraft footpads 2 and 3, were calculated to indicate the footpad penetration depths. The limitations and potential applications of the method of analysis are discussed. A computer program designed to handle the shadow analysis calculations on the IBM 1620 computer is also presented. Author

N68-11641* National Aeronautics and Space Administration. Langely Research Center, Langley Station, Va.
INVESTIGATION OF TETHERED STATION KEEPING

James R. Williams and James J. Adams Washington Dec. 1967 31 p refs
(NASA-TN-D-4258) CFSTI: $3.00 CSCL 22A

A method of Gemini–Agena station keeping using a connecting tether has been investigated both by analysis and by static and moving-base piloted simulations. The method involves spinning the tethered combination about its common center of mass so that tension is maintained in the cable and the vehicles remain close to each other without contact. The analytical study shows that the tethered system is inherently stable while spinning about its axis of maximum moment of inertia. The simulations indicate that pilots can perform the maneuver and can minimize fuel usage with either of the two piloting techniques studied. Author

N68-11643*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMERY NO. 37-47, VOLUME 1 FOR THE PERIOD JULY 1 TO AUGUST 31, 1967. FLIGHT PROJECTS
30 Sep. 1967 150 p refs
(Contract NAS7-100)
(NASA-CR-90544; JPL-SPS-37-47, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A review is presented of engineering and scientific work related to (1) the Mariner IV project, (2) the Mariner Venus 67 project, (3) the Mariner Mars 1969 project, (4) the Voyager project, and (5) the Surveyor project. Such areas as telecommunications, systems, guidance and control, and propulsion are covered in the first four areas. Emphasis is placed on work performed for the Surveyor project; and such areas as power systems, flight control, structures, telecommunications, and propulsion are reviewed. C.T.C.

N68-11715# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKETS ADF-3-24 AND ADF-3-25 LAUNCHED AT CHURCHILL RESEARCH RANGE JULY 1967
Nov. 1967 29 p refs
(SRFB-008) CFSTI: HC $3.00/MF $0.65

This report deals with the engineering aspects of preparing identical infrared photometer payloads and the launchings of Black Brant rockets ADF-III-24 and ADF-III-25, at Churchill Research Range, in July 1967. These experiments measured the intensity profile for the 1.27 macron O_2 emission as a function of altitude in the 40–110 kilometer region. Evening and morning launches were carried out with solar elevation angles of 18.4 degrees and 9.5 degrees respectively. Experiments were provided by the University of Saskatchewan with Bristol Aerospace Limited instrumenting and manufacturing payloads and vehicles. Author

N68-11805 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
TWO BLACK BRANT 2 ROCKETS LAUNCHED AT CHURCHILL RESEARCH RANGE MARCH 1966, AA-103 AND AK-2-104
A. Staniforth, K. A. Steele, and D. H. O'Hara May 1967 47 p refs
(ERB-761)

The engineering aspects of preparing and launching two scientific sounding rockets are described. Vehicles AA-II-103 and AK-II-104 were launched from Churchill Research Range in March 1966 as part of a continuing investigation sponsored by the National Research Council's Associate Committee on Space Research. The report includes a description of the payload structure and of the scientific experiments. In addition, vehicle performance and engineering measurements are discussed. Author

N68-11812*# Perkin-Elmer Corp., Norwalk, Conn.
OPTICAL TECHNOLOGY APOLLO EXTENSION SYSTEM (OTES), PHASE A STUDY Summary Report
Oct. 1967 33 p
(Contract NAS8-20255)
(NASA-CR-90539; Rept.-8900) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Scientific and engineering space experiments which advance optical technology in support of future NASA missions are proposed. The experiments and integrated experiment system fall into broad, yet systematically related, categories: (1) optical technology (diffraction-limited performance of large apertures and fractional arc-second guidance), (2) optical communication and tracking (with deep space emphasis), and (3) effects of aerospace environment on optical technology and laser communications problems. Forty-four experiments, including applications, are identified; and approximately thirty experiments are studied in detail. Five different system concepts were evolved and examined for feasibility with the restraints and guidelines of the optical specifications. C.T.C.

N68-11831* Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
VHF REPEATER EXPERIMENT Final Report
1 Feb. 1967 194 p refs
(Contract NAS5-9593)
(NASA-CR-90507; SSD-70041R) CFSTI: $3.00 CSCL 22B

Details are presented on the design, circuitry, and testing, and operating characteristics for the VHF repeater experiment carried on the Applications Technology Satellite launched 6 December 1966. The objectives of the experiment are to provide continuous voice communications link between a ground control station and aircraft and to operate a meteorological network using data from small unmanned stations. The initial designs and changes in configurations are discussed, and the most difficult problem is identified as the antenna design. The third harmonic and VHF waveform generators, and the antenna deployment mechanism are described and diagrammed. The prelaunch and in-orbit testing are covered. Analyses of the antenna and its components are included. N.E.N.

N68-11832# European Space Vehicle Launcher Development Organization, Paris (France).
ELDO TECHNICAL REVIEW, VOLUME 2, NUMBER 2
Paris Gauthier-Villars 1967 47 p refs In ENGLISH and FRENCH
CFSTI: HC $3.00/MF $0.65

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3. PCM TELEMETRY IN ELDO SATELLITE LAUNCHER L. P. H. M. Korting (Phillips Telecomm. Ind. N.V.) p 99–120 (See N68-11835 02-07)

N68-11833# Grandes Souffleries de Modane-Avrieux, France.
SIMULATION OF STAGE SEPARATION IN EUROPA I LAUNCH VEHICLE [SIMULATION DE LA SEPARATION D'ETAGES DE LA FUSEE EUROPA I]
M. Pierre *In* European Space Vehicle Launcher Develop. Organ. ELDO Tech. Rev., Vol. 2, No. 2 1967 p 77–88 In FRENCH; ENGLISH summary (See N68-11832 02-31)

A simulation study of the condition for separation of the first and second stages of the EUROPA I space vehicle launcher has been conducted in two phases at the aerothermodynamic test center facilities. The first series of tests was carried out in the S3-MA blow-down wind tunnel used as a vacuum chamber. A 1:20 scale model was used, the separation jets being simulated by means of cold jets. The second series took place in the S4B

altitude simulation chamber. A 1:45 scale model was used, the separation jets being simulated by means of a hot gas generator. A few results of measurements are given; they indicate the standard and the possibilities that may be expected of such tests for determining conditions of vehicle stage separation. Author (ESRO)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-11028 Lockheed Missiles and Space Co., Sunnyvale, Calif.
LONGITUDINAL SHEAR CRACK IN AN INFINITELY NARROW PLASTIC ZONE
B. V. Kostrov and L. V. Nikitin 1967 3 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 31, no. 2, 1967 p 334–336

Plasticity effects in problems of crack equilibrium are discussed. A loading-free crack in an unbounded elastic medium in an anti-plane strain state subjected to stress at infinity is considered. Expressions are developed for the longitudinal shear crack, based on the assumption that the plastic zone near the crack terminus is infinitely narrow. The boundary and plasticity conditions are indicated, and graphs illustrating the results are shown. N.E.N.

N68-11054* General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 6: FULL SCALE DYNAMIC TESTING FOR MODE DETERMINATION
D. R. Lukens, R. L. Turney, R. L. Fefferman, J. W. Kittle, and T. E. Reed Washington NASA Dec. 1967 62 p refs
(Contract NAS8-11486)
(NASA-CR-940) CFSTI: $3.00 CSCL 22B

This monograph discusses the concepts, techniques, and problems associated with full-scale dynamic test programs of large booster vehicles, both solid and liquid fueled. This discussion is aimed toward the measurement of the elastic modes that can affect control system analysis. It includes definitions of various excitation systems, suspension systems, mounting systems, instrumentation, data reduction methods, problem areas, and test planning. Author

N68-11089*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 8: ATMOSPHERIC DISTURBANCES THAT AFFECT FLIGHT CONTROL ANALYSIS
B. A. Appleby and T. E. Reed Washington NASA Nov. 1967 40 p refs
(Contract NAS8-11486)
(NASA-CR-942; GD/C-BTD-67-057, V. 8) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The exit phase of flight must, by definition, originate on or near the earth's surface and terminate at some point in space, which will be above the sensible atmosphere. Therefore, all or part of the exit phase of flight occurs in the sensible atmosphere. The analysis of space vehicle systems for this phase of flight must necessarily include the effect of the atmosphere upon the launch vehicle. The atmosphere is non-stationary with respect to the earth's surface and its properties (e.g., density and temperature) vary with respect to time and altitude. These deviations of the non-stationary atmosphere from the stationary position are termed atmospheric disturbances. This monograph is concerned with data on atmospheric disturbances, the criteria derived from the data, and the analyses to be performed to determine the vehicle and control system response to atmospheric disturbances. Specifically excluded from the monograph are the methods of determining loads on the space vehicle structure and the details of analyses. The loads on space vehicle structures, while of great significance, are adequately covered in other literature. The details of analyses are covered in another monograph. The intent here is to discuss what analyses are to be performed and what atmospheric disturbances are to be used, not to present methods of analysis. Author

N68-11098# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
LOAD-INDUCED STRESS SINGULARITIES IN THE BENDING OF COSSERAT PLATES
N. J. Pagano and G. C. Sih Feb. 1967 36 p refs
(Contract Nonr-610(06))
(TR-6; AD-659305)

The solutions to several plate bending problems are presented as governed by a recent theory developed by Green and Naghdi, into which couple-stress is incorporated. Specifically, each problem considered is subjected to boundary conditions emanating from a singular load distribution acting on the free edge of a semi-infinite plate. The method of integral transforms is applied in the solutions. In general, it is found that the singularities in the shear and moment resultants are of the same order as those given in Reissners plate theory, however the detailed structures of these singular functions are altered. The present theory also suggests that, in most cases, the maximum magnitudes of the moment resultants are diminished as compared to the corresponding results given in Reissners theory. Also discussed is the exact relationship between the Green-Naghdi theory and Reissners theory. Author (TAB)

N68-11114# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
GRIFFITH'S THEORY OF BRITTLE FRACTURE IN THREE-DIMENSIONS
M. K. Kassir and G. C. Sih Mar. 1967 36 p refs
(Contract Nonr-610(06))
(TR-7; AD-659306)

The Griffith theory of brittle fracture is extended to the three-dimensional problem of a flat elliptical crack in an otherwise uniform field of tensile and shear stresses. A method for finding the correct expressions of the change in strain energy due to the elliptical crack is developed. This is done by expressing the stresses and displacements in terms of the radius Ro of a large sphere around the crack and by imposing the condition of equilibrium that the stresses or displacements across the spherical surface should agree with the prescribed boundary conditions as R sub o approaches the limit of infinity. The strain energy due to the presence of the elliptical crack is found to be independent of the tension applied parallel to the crack plane at infinity. On the basis of the thermodynamic argument of Griffith, it is also observed that the critical tensile and shear stresses increase rapidly as the ratio of major to minor semi-axes of the ellipse approaches unity. Author (TAB)

N68-11133*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 11: ENTRY DISTURBANCE AND CONTROL
F. D. Staketee Washington NASA Nov. 1967 61 p refs
(Contract NAS8-11486)
(NASA-CR-945; GD/C-BTD-67-023, V. 11) CFSTI: $3.00/MF $0.65 CSCL 22B

This monograph is divided into three basic sections. The first discusses handling qualities, disturbances, and re-entry corridor boundaries. These subjects define the required vehicle/control system characteristics and are considered as design criteria. The

second section describes present state-of-the-art control systems for the fixed- and variable-lift vehicles and contains material on possible problem areas as well as a discussion of some new experimental control techniques. The purpose of this second section is to illustrate how re-entry control systems are currently being designed and to point out some of the problem areas that the designer should be aware of. The third section develops the small perturbation equations that are required for the analysis/synthesis problem. This section also expands the pitch mode equation to include density as an exponential function of altitude. Author

N68-11142 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DETERMINATION OF THE PARAMETERS OF A MECHANICAL ANALOG FOR AXISYMMETRIC VIBRATIONS OF AN ELASTIC CYLINDRICAL VESSEL WITH FLUID
A. A. Pozhalostin 1966 4 p refs Transl. into ENGLISH from Mekh. Tverdogo Tel. (Moscow), no. 5, 1966 p 157–159

Forced small axisymmetric vibrations of an elastic right circular cylinder with an elastic bottom in the shape of a shallow spherical shell filled with a heavy ideal fluid are considered. The vibrations are caused by harmonic motion of the supporting ring. It is shown that the reactive force of the oscillating fluid, which acts on the supporting ring, may be replaced by the reaction of a system of an infinite number of parallel oscillators. The sum of the masses of all the oscillators equals the physical mass of the fluid of the vessel. The velocity potential of the fluid particles is determined under the condition that the fluid is incompressible and that there are no wave motions on the free surface. Author

N68-11152 Lockheed Missiles and Space Co., Sunnyvale, Calif.
VIBRATIONS OF A PLATE (WING) WITH CAVITIES FILLED WITH A MOVING FLUID
Zh. K. Makhortykh 1966 4 p refs Transl. into ENGLISH from Mekh. Tverdogo Tel. (Moscow), no. 5, 1966 p 154–156

The problem of determining the natural vibration frequencies of an orthotropic plate with cavities completely filled with an ideal incompressible moving fluid is considered. A dependence is obtained between natural vibration frequencies of the plate and the velocity of fluid motion, and critical values of the fluid flow velocity are also obtained. Author

N68-11171# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN DIRECT METHODS IN THE NONLINEAR THEORY OF OSCILLATIONS FOR FLAT SHELLS [O NEKOTORYKH PRYAMYKH METODAKH V VELINEYNOY TEORII KOLEBANIY POLOGIKH OBOLOCHEK]
I. I. Vornovich 28 Apr. 1967 52 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), v. 21, no. 6, 1957 p 747–784
(FTD-HT-66-745; TT-67-63250; AD-660437)

The paper examines one general nonlinear operator equation that describes the motion process of certain mechanical systems. Two problems from the nonlinear theory of flat shells are examined as appendixes. Author (TAB)

N68-11191*# Allied Research Associates, Inc., Concord, Mass.
STRUCTURAL DESIGN SYNTHESIS APPROACH TO FILAMENTARY COMPOSITES
George Gerard and C. Lakshmikantham Washington NASA Nov. 1967 40 p refs
(Contract NASw-1378)
(NASA-CR-964; ARA-327-6) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Developments of analysis methods for filamentary composites are discussed. Theoretical predictions of the stiffness and strength properties of a unidirectional composite based on a knowledge of the constituent properties are correlated with experiments for both tensile and compressive loadings. The analysis of multilayer or laminated composites based upon the unidirectional composite properties then requires the rather straightforward use of classical anisotropic shell theory. Some structural aspects of filamentary composites designed for biaxial loads are considered. In particular, certain design restrictions inherent in the use of such composites become evident when compared with the more familiar isotropic sheet. Some of these restrictions can be overcome by a close matching of filament orientations and stress field. These factors serve to emphasize the overwhelming importance of creative structural concepts in the design of successful filamentary composites. Author

N68-11193*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPILATION, METALLURGICAL LABORATORY TESTS—ADVANCED TECHNICAL DEVELOPMENT EFFORT AND SPECIFIC SPACECRAFT
W. G. Grenier Jan. 1964 294 p
(NASA-TM-X-63023; X-673-64-13) CFSTI: $3.00 CSCL 22B

Metallurgical and related tests conducted between August 1962 and January 1964 in direct support of the Advanced Technical Development (ATD) effort and specific spacecraft programs are reported. Spacecraft experimental failure analyses are included, as are evaluations of proprietary coating process and physical properties of specific alloys. Specifically, service reports are presented for the metallographic examination of a skin fragment; bellows, pallet, and airglow failure analyses; the metallurgy of specific aluminum alloys for the OGO; and the effects on races of ball race tests. The ATD studies deal with bearings and gears for vacuum operation, molybdenum disulfide in situ observations, a slip ring assembly and ceramic discs, Alnico V magnetic material, passivation of stainless steel shafts, and preparation of low melting point alloy. M.W.R.

N68-11267# California Inst. of Tech., Pasadena. Engineering and Applied Science Div.
COUPLE STRESSES AND SINGULAR STRESS CONCENTRATIONS IN ELASTIC SOLIDS
Eli Sternberg Sep. 1967 26 p refs
(Contract Nonr-220(58))
(TR-12; AD-660023)

The results summarized and discussed here concern the influence of couple-stresses upon singular concentrations of stress within a linearized Cosserat theory of elastic behavior with constrained rotations. The underlying studies aim at the extent to which the pathological predictions of classical elasticity theory in certain singular problems are altered, mitigated, or eliminated in the presence of couple-stresses. The specific problems treated for this purpose refer to the singularities due to concentrated or discontinuous surface loads, to the corner singularity arising from asymmetric shearing tractions, and to the geometrically induced singularities at the corners of a rigid punch and at the tips of a plane crack. Author (TAB)

N68-11264* General Electric Co., Philadelphia, Pa. Missiles and Space Div.
VOYAGER THERMAL INSULATION SYSTEMS, PHASE 2 Summary Report
S. J. Babjak, M. J. Carpitella, R. W. Carr, A. D. Cohen, F. A. Florio, et al 11 Sep. 1967 99 p Prepared for JPL
(Contracts NAS7-100; JPL-951537)
(NASA-CR-90337; DIN-67SD4405) CSCL 22B

A description is presented of the test fixtures and insulation systems to be used in full scale thermal vacuum tests. The results of a detailed thermal analysis are reported. Several evaluation tests were performed. A second set of rapid depressurization tests were performed using an insulation system with vent holes. The results of these tests determined the required vent hole size and spacing to prevent excessive ballooning during launch ascent. Shock.

vibration, and acoustic tests were performed to evaluate the ability of the insulation system to withstand these environments. A description of these tests and the results are given. Author

N68-11282*# Allied Research Associates, Inc., Concord, Mass.
MINIMUM WEIGHT DESIGN ASPECTS OF STIFFENED CYLINDERS UNDER COMPRESSION
C. Lakshmikantham and H. Becker Washington NASA Nov. 1967 20 p refs
(Contract NASw-1378)
(NASA-CR-963; ARA-327-5) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The effects of minimum weight design on structural stability are reviewed based on a literature survey. The influence of stiffener eccentricity and location on minimum weight design of stiffened cylinders is emphasized. Expressions are cited for determining the critical stress associated with local instabilities of a deep stiffened cylinder; and a governing equation for the general instability of deep-stiffened cylinders is considered. Tables summarize theoretical and experimental data on the effect of stiffener location on the critical stress. The importance of stiffener location is further examined in a comparison of the efficiencies of symmetrical and asymmetrical designs. E.C.

N68-11284 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
GENERAL THEORY OF VIBRATIONS OF CYLINDRICAL TUBES. PART 4: UNCOUPLED TORSIONAL VIBRATIONS OF OPEN TUBES
A. V. Krishna Murty and C. V. Joga Rao Feb. 1967 52 p refs
(AE-158S)

Based on the ease in satisfying the free-edge boundary condition, open tubes are classified into two types, A and B. Type B tubes have a more complicated free-edge boundary condition than type A tubes. An alternate formulation is evolved for type B tubes; this makes the free-edge boundary condition as simple as in type A tubes. A simply supported open tube, with the cross-section given by $p = S/2\pi \sin 2\pi s/S$, is analysed exactly as well as by using approximation equations; errors in using the first order approximation equations are discussed. A simply-supported open tube of I-section, representative of type B tubes, is analysed by using first and second order approximation equations. Author

N68-11311# Naval Ship Research and Development Center, Washington, D. C.
LARGE-SCALE MODEL EVALUATION OF A WELDED, WEB-STIFFENED TITANIUM SANDWICH HULL FOR DEEP-SUBMERGENCE APPLICATIONS Final Report
Ely G. Fishlowitz Jul. 1967 52 p refs
(NSRDC-2412; AD-660205)

A 9-ft-diameter, web-stiffened titanium sandwich cylindrical hull with hemispherical end closures was designed for deep-submergence applications. A 30-in.-diameter model was fabricated and hydrostatically tested to demonstrate fabricability and performance under simulated service loads. All fabrication was performed using procedures applicable to full-scale hulls. Prior to the construction of the complete model, a trial manufacturing section of the sandwich hull was successfully built to demonstrate fabricability. Specimens of weld and base material from this trial section were found to have excellent material properties. The fabricated model, complete with hemispherical closure head and other structural details, was fabricated to close tolerances and possessed a high degree of structural integrity during hydrostatic testing. Results of the pressure tests were shown to be highly predictable; experimental and calculated collapse pressures agreed within 4 percent. Author (TAB)

N68-11328# Wisconsin Univ., Madison. Mathematics Research Center.
THE SEMI-INFINITE CYLINDER WITH PRESCRIBED END DISPLACEMENTS
G. W. Swan Jul. 1967 37 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-755; AD-660503)

The problem considered here is that of a homogeneous elastic semi-infinite circular cylinder which is free from stress on its curved boundary but has prescribed radial and longitudinal displacements on its plane face. The associated eigenvalue problem is investigated and a method is given for the determination of any particular eigenvalue. The first sixteen eigenvalues are quoted. Eigenfunction expansions are developed for the displacements and in order to satisfy the conditions on the end face two infinite sets of linear equations have to be solved. An approximate solution for a particular case is presented. Author (TAB)

N68-11355*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BALLISTIC LIMIT OF ALUMINUM PLATES DETERMINED BY AN EXPLODING FOIL GUN TECHNIQUE
Emilio Alfaro-Bou and Robert G. Thomson Washington Dec. 1967 17 p refs
(NASA-TN-D-4259) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An understanding of the perforation of finite-thickness plates is essential to the proper design of spacecraft to insure protection from meteoroid impact. An investigation was therefore initiated to determine the ballistic limits of finite-thickness plates and to compare these results with existing theoretical predictions. The impact of meteoroids on thin aluminum plates is simulated in an exploding foil gun facility. The exploding foil gun can fire a large number of shots in a relatively short time with a range of projectile velocities from 1 to 8 km/s. The exploding foil gun facility is used in an experimental program to determine the ballistic limits of aluminum plates of varying thickness. The information gathered from this experimental program indicates that the ballistic limit is linearly dependent on the plate thickness and the experimental data correlate well with the theory of ballistic limit developed from a visco-plastic model. Hence, the current practice of using semi-infinite penetration data in predicting the ballistic limits of thin plates is incorrect. Author

N68-11422# Brown Univ., Providence, R. I. Engineering Div.
SURVEY OF METHODS OF ANALYSIS FOR PLASTIC DEFORMATION OF STRUCTURES UNDER DYNAMIC LOADING Final Report
P. S. Symonds Jun. 1967 250 p refs
(Contract Nonr-3248(01) (X))
(BU/NSRDC/1-67; AD-659972)

The survey provides a critical study of methods for the analysis of metal structures under dynamic loads leading to large plastic deformation. Relevant material behavior and analytical and numerical methods are summarized. Emphasis is put on critical study of experiments, particularly on beams, with consideration of strain rate sensitive plastic behavior. Author (TAB)

N68-11434*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEM ENGINEERING CONSIDERATIONS IN SPACECRAFT DESIGN
A. G. Conrad 15 Jun. 1967 9 p refs
(Contract NAS7-100)
(NASA-CR-80423; JPL-TR-32-980) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Consideration of the spacecraft system as an entity is the most significant aspect of system engineering as applied to the design of planetary spacecraft. The system design activity discussed in this report is limited to those considerations involved with the establishment of the required spacecraft system capability, the

development of the design concept, and the generation of the subsystem functional capability requirements. Author

N68-11472# Library of Congress, Washington, D. C. Aerospace Technology Div.
HIGH PARAMETER ENERGY MATTER INTERACTION Surveys of Foreign Scientific and Technical Literature
23 Oct. 1967 63 p refs
(ATD-68-14-72-1; AD-660119)

Contents: Mechanics of continuous media (general, shock waves and impacts, thermal effects); Mechanics of shells and other shapes; Dynamic strength of materials (crystalline materials (metals), plastic materials (polymers)); Experimental methods and results; Monographs and reviews. TAB

N68-11485*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 5: IMPEDANCE TESTING FOR FLIGHT CONTROL PARAMETERS
David R. Lukens Washington NASA Dec. 1967 27 p refs
(Contract NAS8-11486)
(NASA-CR-939; GD/C-BTD-67-045) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Ways of determining equivalent rates that describe the local flexibility of launch vehicle control system structures and their mounting and associated brackets are presented. Recommended practices are enumerated and include impedance methods, typical forms of the impedance plot, determination of mechanical impedance by test, force and motion requirements, instrumentation requirements, use of impedance in stability and control analysis, and simulation of equivalent systems. It is noted that these spring rates and impedance techniques used to determine them may also be used to evaluate motions for clearance and environmental studies. C.T.C.

N68-11489*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PANEL LOSS FACTORS DUE TO GAS-PUMPING AT STRUCTURAL JOINTS
G. Maidanik and E. E. Ungar Washington NASA Nov. 1967 62 p refs
(Contract NAS5-9694)
(NASA-CR-954; Rept.-1475) CFSTI: HC $3.00/MF $0.65 CSCL 13M

The recently observed fact that the high-frequency structural damping due to riveted joints is associated with "gas-pumping" in the space between overlapping surfaces is subjected to theoretical and experimental study. A theory is developed, which attributes the damping of plates with riveted-on beams to viscous losses associated with the tangential gas motions in the beam-plate interspace that are generated by normal relative motions of the adjacent beam and plate surfaces. Reasonable agreement is found between theoretical predictions and experimental data obtained for three different gases over a wide range of pressures. Author

N68-11493# Brown Univ., Providence, R. I. Div. of Engineering.
UNLOADING WAVES FOR COMBINED LONGITUDINAL AND TORSIONAL PLASTIC WAVES
R. J. Clifton Sep. 1967 20 p refs
(Contract ARPA SD-86)
(ARPA-E50; AD-659971)

Assuming a one-dimensional rate independent theory of combined longitudinal and torsional plastic wave propagation in a thin-walled tube, it is shown that the velocity of unloading waves, c sub u, must satisfy either c sub s < c sub u < c sub 2 or c sub f < c sub u < c sub o where c sub s and c sub f are respectively the velocities of slow and fast plastic waves of combined stress, c sub 2 and c sub o are respectively the elastic shear wave speed and the elastic bar velocity. It is also shown that the velocity of loading waves (moving elastic-plastic boundaries across which loading takes place), c sub l, must satisfy c sub l < c sub s or c sub 2 < c sub l < c sub f or c sub o < c sub l. The general features of the discontinuities associated with each type of loading and unloading wave are established, and examples are presented of unloading waves overtaking simple waves. Author (TAB)

N68-11540# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
DYNAMIC MECHANICAL BEHAVIOR OF A COMPOSITE VISCOELASTIC MATERIAL Annual Report
William St. Lawrence and M. G. Sharma Jul. 1967 93 p refs
(Contract DA-31-124-ARO(D)-116)
(AROD-3263-16-E; AD-659779)

An investigation was made into the dynamic mechanical behavior of a soft binder material (Solithane 113), which had dispersed in it a number of small aluminum particles. By varying the volume fraction concentration of the filler material, the effect of the filler concentration on the dynamic characteristics was determined. A theory was developed which considered the dynamic behavior of the composite material as a function of the moduli, and volume fraction of each constituent material. This theory was then used to predict the materials dynamic properties for filler concentrations, and frequencies studied in the experimental investigation. The theoretically predicted moduli values were compared with the experimental results showed that for low filler concentrations and at low frequencies the correlation between theory and experiment was good. At high frequencies and filler concentrations the correlation was found to be poor. TAB

N68-11556 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE COLLISION OF TWO PLATES WITH GREAT SPEED [SOUDARENIYE DVUKH PLASTIN S BOL'SHOY SKOROST'YU]
E. I. Andriankin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 89–98 refs (See N68-11548 02-34)
(MT-63-262)

Collision between two plates moving at high speeds leading to their total destruction and transformation into a gas escaping into a vacuum has been studied. It is shown that almost all the energy of the gas is transmitted in the direction of the shock and that a significant decrease in the energy flux takes place only in the case of collision against a thick obstacle. Increasing the density of a colliding object intensifies the energy transmission. A criterion is defined for strong discontinuity generation at the reflection of a rarefaction wave from the surface of a collision. The problem of the collision of two plates of identical density and thickness, for which the intensity of the shock waves is a constant, is described by an exact isentropical solution which is valid for a series of discrete values of adiabatic exponent γ. If the density of a colliding object differs from that of its obstacle, an exact solution may be found only for $\gamma = 3$. In cases where the thickness of each is aribtrary, an approximate method is used which is based on the assignment of density distribution as a polynomial whose coefficients are selected on the basis of the principles of conservation. Author

N68-11573 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEADY ANISOTROPIC CREEP OF DISKS [USTANOVIVSHAYASYA ANIZOTROPNAYA POLZUCHEST' DISKOV]
O. V. Sosnin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 195–200 ref (See N68-11548 02-34)

An analysis is made of the state of stress described by orthotropic characteristics in a disk under conditions of creep. The material of the disk is orthotropic and plastically incompressible, so that the relationship between the plastic strain and shear stress is not dependent on the magnitude of normal stresses. Under the assumption that the principal axes of anisotropy coincide with

those of the stresses, it is shown that it is possible to generalize the Tresca criterion in order to establish the relationship between the strain rate and stress. The curves of equivalent stresses (represented by the distorted Tresca hexagon) and of corresponding equivalent rates of strain are constructed in the octahedral plane and shown in diagrams. A sample steady-creep analysis of uniformly heated disks with and without holes in the center is discussed, and expressions for tangential and radial stresses are derived. The results of stress calculations in both cases for ratios of tangential-to-normal creep rates from 0.1 to 10.0 are shown in a diagram. The radial creep rate is not contained in the solution. It is concluded that in designing disks for steady creep by using Tresca's criterion, the effect of anisotropy can be disregarded if the creep characteristics in the orthotropic planes vary by less than one order. Author

N68-11574 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF CREEP OF GLASS PLASTIC PLATES [K RASCHETU NA POLZUCHEST' PLASTINOK IZ STEKLOPLASTIKOV]

G. I. Bryzgalin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 201–207 refs (See N68-11548 02-34)

Clear plastics—anisotropic materials like vitreous cloth, fiber, etc., are impregnated with resin; the vitreous filler gives stability and rigidity to the construction; the resin insures joint action of the separate fibers and layers. Polymers used as connecting material have significant creep even at room temperature. For appropriate choice of direction and intensity of reinforcement, one obtains constructions with high stability and insignificant creep. The author shows a method for determining the stressed state and supporting capacity of constructions of clear plastic under conditions of creep. In conclusion he notes that this method does not cover every class of problems on creep of constructions of clear plastic. If the tangent stresses on the main areas of anisotropy are missing or are insignificant, and if one considers constructions of woven clear plastic, it may be necessary to calculate the creep along the main directions of anisotropy. Author

N68-11582 National Aerospace Lab., Tokyo (Japan).

DEFLECTION ANALYSIS OF VARIABLE THICKNESS CANTILEVER PLATE

Taketoshi Hanawa and Shinichi Koshide 1967 31 p refs In JAPANESE; ENGLISH summary

(NAL-TR-138) CFSTI: $3.00

The use of the Rayleigh–Ritz procedure is proposed for the analysis of the deflection of variable-thickness cantilever plate. The analysis is carried out on the assumption that the deflection of a plate is expressed by a general power series of x and y, which satisfies the geometrical boundary conditions; and the conception of natural boundary condition is advantageously utilized. The plate thickness is also given by a power series of x and y. As a numerical example, the problem of a plate with linearly tapered thickness, subjected to a single concentrated load, was considered. The actual calculation was carried out with a test function which takes the form of a series with 10 terms. Experimental verification of the calculated results followed, and revealed: (1) For the deflection of the plate with linearly tapered thickness, a satisfactory result is obtained by taking 10 terms for the test function. (2) For the surface strain, the result is not sufficiently satisfactory, but it clearly shows the general tendency of the strain distribution. (3) For cantilever plates, the variation of the plate thickness has generally a large influence on the deflection and the surface strain. Author

N68-11606 Joint Publications Research Service, Washington, D. C.

ACHIEVEMENTS AND TASKS OF TECHNICAL MECHANICS IN THE ENGINEERING AND CONSTRUCTION SCIENCES

Karoly Szechy *In its* Rept. of the Tech. Sci. Dept. of the Hung. Acad. of Sci. 30 Nov. 1967 p 79–90 (See N68-11601 02-34)

Load bearing structure theory and other efforts related to the engineering and construction sciences are noted. Analysis of the stress and deformation state of elastic and nonelastic systems is considered under the headings of elasticity, viscoelasticity, plasticity, and stability and design theories; and model analysis, mechanics and granular materials, kinetics and kinematics, and vibration problems and theory are mentioned. Areas of technical mechanics in which domestic research has been inadequate are noted. M.W.R.

N68-11612*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

DUALITY IN FINITE ELEMENT METHODS, SEPTEMBER 16, 1966–APRIL 30, 1967

Z. M. Elias May 1967 77 p refs

(Grant NGR-22-009-059)

(NASA-CR-90500; R67-16) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The duality that exists between the basic equations and the dependent variables of the problems of stretching and of bending of plates is applied to the finite element method. A displacement method in the stretching problem is a stress function method in the bending problem and vice-versa. The displacement method for the stretching problem and the dual stress function method for the bending problem are applied to orthotropic triangular elements. The derivation of the dual purpose stiffness–flexibility matrix is carried out explicitly. Author

N68-11632* Oklahoma State Univ. Research Foundation, Stillwater.

HYPERVELOCITY IMPACT OF MICROPARTICLES Quarterly Progress Report, Apr. 1–Jun. 30, 1968

F. C. Todd and B. A. Sodek, Jr. (Ph.D. Thesis) 30 Jun. 1968 103 p refs

(Contract NASr-7)

(NASA-CR-90412; QPR-23) CFSTI: $3.00 CSCL 20K

Calculations for the impact of a spherical aluminum microparticle on a semi-infinite aluminum target are presented. A numerical method was developed and tested for the solution of a set of Eulerian, dimensionless, equations which include shock wave propagation and target motion. Also, a Fortran IV computer program was used to obtain solutions for all cases up to a time when the decay of the primary shock front is significant. A basic feature of these solutions is the formation of two shock waves at the position of initial contact of microparticle and target. Another feature noted in curves was the ejection of material above the original target surface. It is surmised that (1) inclusion of plasma properties in the equation of state, and the addition of plasma conservation equations to the modified Eulerian set, would explain the radiation observed in the impact process; and (2) these extensions, the refinement of the hydrodynamic model to include plasma, plastic, and elastic material should lead to a better understanding of the hypervelocity impact problem. S.C.W.

N68-11671 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE REFLECTION OF PLANE ELASTIC WAVES FROM AN ARBITRARY INHOMOGENEOUS LAYER IN THE CASE OF NORMAL INCIDENCE

E. V. Nikol'skiy *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 115–130 (See N68-11661 02-23)

This paper presents a system of integral equations whose solution is preferable to the solution of differential equations because: it shows the physical essence of the phenomenon—the representation of the wave field in the form of a sum of "secondary" waves that have undergone a completely determined number of reflections; it permits easy estimates through successive approximations; after some modification it allows bringing up the question of solving inverse problems. Author

N68-11672 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING SOME ESTIMATES FOR THE SPECIFIC SURFACE OF CRACKS FORMED IN THE CASE OF DYNAMIC ACTION UPON A SPHERICAL CAVITY IN A MAGNETIC FIELD
Yu. K. Bratukhin and M. I. Shliomis *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 39–47 refs (See N68-11661 02-23)

The theoretical determination of the specific surface of cracks and the average size of the blocks formed in the case of dynamic action, such as an explosion or an impact, upon a solid is of considerable interest in connection with various applications and, at the same time, involves very great difficulties with regard to principle and in connection with computation. A rigorous and sufficiently complete solution of this problem does not appear to be attainable at this time. It is therefore expedient to direct our attention to some simple relationships that are obtained from general conceptions of the phenomenon and from considerations of dimensionality, this being the subject of the present memorandum. Author

N68-11673 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF THE THIXOTROPY OF VISCOELASTIC MEDIA WITH A CONTINUOUS DISTRIBUTION OF THE RELAXATION TIME
A. I. Leonov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 137–157 refs (See N68-11661 02-23)

The phenomenological theory of thixotropic variations in deformable viscoelastic media was analyzed for the case of continuous relaxation time distributions. The method attempts to treat simultaneously the complete relaxation spectra as well as the non-Newtonian nature of viscosity in deformable polymers. Author

N68-11674 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TORSIONAL LOSS OF STABILITY IN THE CASE OF PLASTIC DEFORMATION
V. D. Klyushnikov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 158–164 refs (See N68-11661 02-23)

This paper considers torsional loss of stability in the case of plastic deformations on a new model. Author

N68-11675 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VISCOPLASTIC FLOW IN NONCIRCULAR CYLINDERS IN THE PRESENCE OF A PRESSURE GRADIENT
G. I. Bykovtsev and A. D. Chernyshev *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 165–171 refs (See N68-11661 02-23)

This paper presents a particular solution of a problem concerning the flow of a viscoplastic material in a noncircular cylinder parallel to its generatrices under the influence of a constant pressure gradient. Author

N68-11676 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CREEP AT VARIABLE TEMPERATURES UNDER CONDITIONS OF A COMPLEX STRESSED STATE
V. S. Namestnikov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 172–176 refs (See N68-11661 02-23)

This paper presents experimental data on creep in a complex stressed state at variable temperatures with consideration of different variants of plasticity theory. Author

N68-11677 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE THEORY OF HEREDITY TO THE PROBLEM OF THE RECALCULATION OF DATA PERTAINING TO THE RELAXATION OF CREEP STRESSES
A. A. Chizhik *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 177–183 (See N68-11661 02-23)

Starting with conditions of uniform stress application and conditions of uniform cumulative deformation an analytic expression was derived. The problem is applied to the case of creep and stress relaxation under conditions of sudden specimen loading. Author

N68-11678 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POSTCRITICAL DEFORMATIONS AND THE STABILITY OF A SLOPING SPHERICAL SEGMENT
L. I. Shkutin *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 184–190 refs (See N68-11661 02-23)

The shape of a convex shallow shell deflected as deeply as possible is assumed to be a mirror image of the initial shell except for the edge-adjacent area, where an additional deformation takes place. The energy of deformation in this area is determined by applying the theory of edge effect. This method of investigation leads most quickly to the solution of the problem and is especially convenient for shallow shells because the effect of boundary conditions on the value of the buckling energy, i.e., on the magnitude of the lower critical load, can be easily estimated. The application of this method is demonstrated in the investigation of the deformation and stability of a thin-walled spherical segment clamped along its edge and subjected to uniform normal pressure on the convex side. Formulas are derived for the energy of deformation and the lower and upper critical loads, and the behavior of the segment is discussed and illustrated by diagrams. The possibility is pointed out of generalizing the results obtained for an arbitrary shallow shell of revolution having a continuously variable thickness and subjected to other types of loading. Author

N68-11679 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPROXIMATE SOLUTION OF THE INDENTATION OF SLOPING CONES INTO A RIGID PLASTIC MEDIUM
V. V. Varnello *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 191–197 refs (See N68-11661 02-23)

A formula for Meyer hardness H_m is obtained and the results from it are compared with the reference data. Graphs and calculations show their satisfactory agreement. Author

N68-11702# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
THEORETICAL AND EXPERIMENTAL COMPRESSIVE STRENGTH OF FLAT BONDED PANELS WITH A 7075- AND 7178-ALUMINIUM ALLOY SKIN, STIFFENED WITH 7178-ALUMINIUM ALLOY HAT-SECTION STRINGERS
A. C. W. Michon Sep. 1966 55 p
(S-122)

For the calculation of the theoretical compressive strength of the F.28 bonded inner wing upper surface compression panels which consist of a skin in 7075-T6 material stiffened with hat-section stringers in 7178-T6 material the E.M.F. method (Experimental Method Fokker) as presented in the Fokker Strength Handbook, will be applied. To verify these calculations 12 bonded panels, which were composed of a 7075-T6 aluminium alloy skin and 4 hat-section stringers in 7178-T6 aluminium alloy, have been tested on the Avery Compression Testing Machine of the N.L.R. To investigate the influence of a 7178-T6 skin instead of a 7075-T6 skin, tests have also been executed on 12 bonded hat-stiffened panels with a skin of 7178-T6 aluminium alloy in combination with the 7178-T6 stringers and again with the same column lengths and skin and stringer thicknesses as the aforementioned. For

comparison with the test data, the compressive strengths calculated with the nominal skin and stringer thicknesses and minimum mechanical properties, have been corrected using measured thicknesses and measured mechanical properties. Since the panels have two unloaded free edges all the results will be corrected for the influence of these free edges. From the comparison it can be concluded that the theoretical strength of these bonded panels, either with a 7075-T6 skin or a 7178-T6 skin, calculated according to TH 3.881 of the Fokker Strength Handbook is sufficiently conservative in the tested range of column lengths. The panels with a 7178-T6 skin averaged about 2.5 percent higher than those with a 7075-T6 skin. Author

N68-11764# Brown Univ., Providence, R. I. Engineering Div.
MECHANICAL AND THERMODYNAMIC CONSIDERATIONS OF AN ASSEMBLAGE OF HOMOGENEOUS ELASTIC-PLASTIC STATES
David Rubin Jun. 1967 57 p refs
(Contract Nonr-562(20))
(TR-54; NONR-562(20)/54; AD-659943)

The mechanics and the thermodynamics of plastic deformation are considered in terms of a general assemblage or continuum of elastic perfectly-plastic elements or states. Such models not only match the external mechanical behavior of real materials structures and continua, but they also afford a simple thermodynamic definability. A consideration of the internal behavior shows that the stress-free state has the maximum elastic range. Hardening in the sense of an increasing macroscopic elastic range is accompanied by a release of stored strain energy; the stress-free state always is restorable. This behavior is appropriate for real structures and continua. However, it is precisely these continuum characteristics which make the assemblages inappropriate models of material behavior. Barriers to continuing plastic deformation are required which do exist on the microscale but lie outside of the scope of the most complex of these thermodynamically well-defined assemblages. Author (TAB)

N68-11776* Louisiana State Univ., Baton Rouge. Div. of Engineering Research.
THE INFLUENCE OF JOINT THERMAL CONDUCTANCE OF THE GAP BETWEEN BOLTED PLATES CAUSED BY FASTENER LOADS Semiannual Progress Report, 1 Jun.–1 Dec. 1967
C. A. Whitehurst 1 Dec. 1967 140 p refs
(Grant NGR-19-001-035)
(NASA-CR-90549) CFSTI: $3.00 CSCL 20K

The primary concern is to develop an analytical technique to describe the steady state temperature distribution and interface thermal conductance in a bolted joint. A detailed review of the literature showed: (1) the present theory is inadequate and a comprehensive analytical approach to this problem was not available; (2) there were a number of difficulties preventing the development of an entirely analytical method; (3) it is necessary to determine the normal stress distribution in the joint and the deflection of the joint members due to those stresses in order to describe the interface conductance in a bolted joint. Normal stress distributions under button-head and fillister-head bolts were measured and the results indicate that the common assumption of a uniform stress is not always valid. Measurements of the interface stress distribution between thin bolted plates were made. An analytical technique, employing the method of superposition, was developed to describe the deflection of thin circular plates with center holes, subject to non-uniform partial loading. The resulting equations were programmed for solution on a digital computer. The validity of this analysis was checked experimentally for thin circular and square plates. Author

N68-11834# Hawker Siddeley Dynamics, Ltd., Hatfield (England).
GENERAL INSTABILITY OF STIFFENED THIN SKINNED CYLINDERS IN COMPRESSION
J. K. Bennett *In* European Space Vehicle Launcher Develop. Organ. ELDO Tech. Rev., Vol. 2, No. 2 1967 p 89–98 refs
(See N68-11832 02-31)

When Blue Streak was being converted to its role as the first stage of a satellite launching vehicle, it was necessary to redesign the forward end of the structure. The problem was to find what stringer/frame combination gave the minimum weight compatible with the load carrying requirement. No published method appeared to be available for relatively short cylinders with irregularly spaced frames subject to compression loads, so the method outlined in this paper was therefore developed. Author (ESRO)

N68-11881 Technische Hochschule Munchen (West Germany).
CALCULATION OF LEVEL AND THREE-DIMENSIONAL OSCILLATIONS OF TUBULAR SYSTEMS [BERECHNUNG EBENER UND RAEUMLICHER SCHWINGUNGEN VON ROHRSYSTEMEN]
Qazi Adul Baqee (Ph.D. Thesis) 1966 170 p refs In GERMAN
CFSTI: $3.00

A deformation analysis is used to determine bending effects at various vibration frequencies in a pipe system consisting of straight and semi-circular members. Differential equations are formulated and used to obtain load and moment functions for symmetrical and asymmetrical vibrations. Theoretical results are then correlated with measured values. Results show somewhat higher values for calculated values; basic self-oscillation calculations were about 7% higher than actual frequency measurements. Transl. by G.G.

N68-11885 Technische Hochschule Munchen (West Germany).
THE SONIC AND SUPERSONIC ABSORPTION OF MATERIALS IN THEORY AND PRACTICE, ESPECIALLY IN REFERENCE TO THE CONSTRUCTION OF AN ACOUSTICAL MODEL BUILDING OF A 1:10 SCALE [DIE SCHALL- UND ULTRASCHALLABSORPTION VON MATERIALIEN IN THEORIE UND PRAXIS, INSBESONDERE IM HINBLICK AUF DEN BAU AKUSTISCH AEHNLICHER MODELLE IM MASSSTAB 1:10]
Dieter Brebeck (Ph.D. Thesis) [1967] 154 p refs In GERMAN
CFSTI: $3.00

Approximation methods were applied to calculate the geometrical, statistical, and wave theoretical construction parameters of various reverberation rooms and materials. Mathematical models for acoustic wave propagation, reflection, bending, and absorption at boundaries as well as the behavior of the chambers were evaluated and compared with measurements on geometric and acoustic similar construction models. Special emphasis was placed on the acoustic reproduction of geometric model boundaries, the degree of absorption involved in ceilings, walls, persons, etc., and their influence on the overall acoustic field. Transl. by G.G.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-11018 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
A REVIEW OF THE STUDIES ON FLAME STABILIZATION PHENOMENA
V. K. Jain and H. S. Mukunda May 1966 35 p refs
(AE-163A) CFSTI: $3.00

Experiments on bluff body and opposed jet flame holders are reviewed and the results are evaluated in terms of approach stream velocity and turbulence, blow off velocities, air fuel ratio, and mass injection rate of secondary stream. The flame holders and flow are described, and details are given on the experimental procedures. Among the findings are: (1) A single bluff body flame holder has a flame stability and small rate of flame spreading. A multiple flame holder has narrow limits of stability, larger rate of flame spreading, and higher combustion efficiency. Therefore a compromise is recommended. (2) The state-of-the-art in using recessed ducts and opposed jets appears to be still in its infancy, and recommendations are made for areas of further study. N.E.N.

N68-11027 Lockheed Missiles and Space Co., Sunnyvale, Calif.
STATIONARY MOTION REGIME OF VAPORS OF MATERIAL HEATED BY RADIATION IN THE PRESENCE OF LATERAL SPREADING
I. V. Nemchinov 1967 25 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 31, no. 2, 1967 p 300–320

A discussion is presented on the stationary and quasi-stationary motion of the heated gas under various conditions. The equations of stationary motion and vapor heating in the presence of radial symmetry are given, and the condition of continuous acceleration of the gas is considered. Expressions are developed for the magnitude of maximum heating and the plane motion of a heated gas. The spherically and cylindrically symmetric motions are investigated, along with the quasi-stationary motion in a long slender cylinder. The dependences of mass discharge, pressure on the solid surface, and maximum gas temperature on the total incident radiation flux and the radius of the sphere are also discussed. N.E.N.

N68-11038*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF MOLECULAR STRUCTURE ON THE THERMOCHEMICAL PROPERTIES OF PHENOLICS AND RELATED POLYMERS
John A. Parker and Ernest L. Winkler Washington Nov. 1967 40 p refs Presented at the Symp. on Phenolic Chem., Natl. Meeting of Am. Chem. Soc., Miami, Fla., Apr. 1967
(NASA-TR-R-276) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Phenolic resins and related polymers were synthesized by established methods to provide different types of char-forming polymers for pyrolysis studies. Certain features of the molecular structure of these polymers which determine the char yield have been characterized. Pyrolysis studies were carried out under both thermogravimetric conditions and in environments simulating reentry ablation to relate the char yields of these polymers to their molecular structure. It has been possible to account for the char-forming reactions of these phenolic derived resins in terms of a general pyrolysis mechanism for these classes of polymers. An analysis based on this mechanism was developed which predicts from molecular structure the observed thermogravimetric char yields accurately over a range from 11 to 65% yield. This analysis makes it possible to control the primary rates of vapor to char production as required for particular heat-shield applications. Composites from these polymers were developed and tested under one-dimensional pyrolysis simulating reentry ablation. Up to applied heating rates of about 25 cal $cm^{-2}sec^{-1}$, the observed char yields agree quite closely with those obtained in thermogravimetric tests. It is tentatively concluded that the primary char-forming processes with these classes of materials are independent of polymer heating rate over a range of temperature rise rates varying from 2° to 5000°C per minute. With certain composites and at heating rates greater than 25 cal $cm^{-2}sec^{-1}$ an additional amount of char is formed due to secondary pyrolysis of vapor products within the char matrix induced by high char temperatures. These secondary processes seem to depend on surface temperature, impact pressure, and the chemical nature of the vapor products. Author

N68-11053* North Dakota Univ., Grand Forks.
A MATHEMATICAL INVESTIGATION OF A HEAT TRANSFER CONFIGURATION
Paul G. Nelson (M.S. Thesis) Jun. 1967 41 p
(Grant NGR-35-002-003)
(NASA-CR-90236) CSCL 20M

The Laplace transformation method of dealing with differential equations is applied to the solution of conductive heat transfer problems. The temperature distribution in a thin skin, with the end of a straight wire attached to it, is obtained. The case of the wire bent along the skin for some distance is also investigated, and the effects of thermal resistance and extra capacity are evaluated. An additional solution to the bent wire problem is determined involving dimensionless parameters by making appropriate substitutions. N.E.N.

N68-11073# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF INDIVIDUAL SUBSTANCES. VOLUME 1: CALCULATION OF THE THERMODYNAMIC PROPERTIES, PART 3 (CHAPTERS 28 THROUGH 31)
A. V. Gurvich, G. A. Khachkuruzov, V. A. Medvedev, I. V. Veyts, and G. A. Bergman 13 Mar. 1967 626 p refs Transl. into ENGLISH from the book "Termodinamicheskiye Svoystva Individual'nykh Veschestv; V Dvukh Tomakh, Tom 1; Vychisleniye Termodinamicheskikh Svoystv" Moscow, Izd-Vo An SSSR, 1962 p 859–1162
(FTD-HT-66-251; TT-67-63056; AD-659679)

Methods of calculating the thermodynamic properties of individual substances are described, and critical analysis is given of the literature data until 1960, including the constants necessary for the calculation of the tables of the thermodynamic properties (molecular constants, heats of formation and heats of phase transitions, specific heats, dissociation energies, etc.), the choice of the values of these constants accepted in the Handbook is substantiated and their values are estimated for such cases where experimental data are lacking. This 3rd part of Vol. 1 treats the following substances: lithium and its compounds; alkali metals and compounds of sodium and potassium with fluorine and chlorine; zirconium, lead, mercury and their compounds; inert gases (He, Ne, Ar, Kr, Xe) and the electron gas (e-). Appendixes covering the following topics are included: isotope composition and nuclear spins of the chemical elements; fundamental physical constants and transformation factors; formulas for the principal moments of inertia of molecules; concise data from the theory of molecular vibrations and formulas for the frequencies; consideration of the intermolecular interactions in the calculation of the thermodynamic functions of gases; critical constants. TAB

N68-11115# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ANALYTICAL AND EXPERIMENTAL STUDY OF A MELTING PROBLEM WITH NATURAL CONVECTION
Yin-chao Yen Jul. 1967 16 p refs
(CRREL-RR-234; AD-659780)

The correlation by O'Toole and Silveston (1959) of natural convection heat transfer for fluids confined between two parallel horizontal plates has been extended to the case involving phase change. The new correlation, which is applicable for melting from below in a water-ice system, is described with special focus on theoretical considerations, estimation of heat flux, and the experimental and analytical results. In all experiments, bubble-free, homogeneous ice samples were prepared beforehand to assure

reliable and reproducible results. In general, the results from theory and experiment are in close agreement. Author (TAB)

N68-11144* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CHARTS FOR EQUILIBRIUM ISENTROPIC EXPANSION OF AIR BEHIND SHOCKS UP TO 50000 FEET PER SECOND (15.24 KILOMETERS PER SECOND)
Ernest V. Zoby and Wayne D. Erickson Washington Nov. 1967 51 p refs
(NASA-TN-D-4247) CFSTI: $3.00 CSCL 20M

Isentropic state properties (enthalpy, temperature, and density) have been computed for equilibrium air as a function of pressure relative to the respective stagnation-point conditions behind normal shocks for a wide range of velocities and altitudes. The free-stream velocities ranged from 10,000 to 50,000 ft/sec and the altitudes ranged from 50,000 to 300,000 feet. These isentropic properties with the associated normal shock properties of pressure, temperature, and density were correlated with nonreacting perfect-gas isentropic and normal shock expressions. Charts of the correlation parameters are presented as well as a simple procedure for computing the properties. Author

N68-11234# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE INFLUENCE OF COMBUSTION OSCILLATIONS ON THE JET IN STILL AIR AND IN SUPERSONIC FLIGHT
E. Edward Ehlers Aug. 1967 74 p ref *Its* Math. Note No. 517
(D1-82-0629; AD-660055)

The equations of unsteady motion for compressible flow were linearized under the assumption of small perturbations in the uniform parallel jet and exterior streams. The equations were solved for a supersonic jet issuing into still air and for a supersonic jet into a supersonic stream by means of the Laplace transformation in the time and axial variables. The boundary conditions of continuous pressure and flow inclination along the jet and stream interface were satisfied on the undisturbed location of the interface and the perturbation pressure at the jet exit was assumed to be cosinusoidal. The shape of the jet boundary and density perturbation in the jet stream were computed for several two dimensional flows. Near the jet exit the jet boundary deflection has maximum and minimum amplitudes at the points where the two interior Mach lines from the edges of the jet exit and their reflections intersect the jet interface. The transform solutions for axially symmetric flow were also obtained, but only the shape of the jet boundary in still air was computed. Author (TAB)

N68-11339# General Electric Co., Schenectady, N. Y. Research and Development Center.
HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS Quarterly Report, Feb.-Jun. 1967
F. W. Staub Jul. 1967 46 p refs Sponsored jointly by U.S.-EURATOM
(Contract AT(30-1)-3679)
(NYO-3679-1; QR-1)

In activities devoted to measurement of the initiation and early development of subcooled void profiles of low pressure boiling water, including the design of the loop and test section are described. The facility for the test equipment was prepared and the loop constructed except for insulation and electrical wiring of the major components. Bench tests of the pressure measurement technique in an air–water loop were completed and bench tests of the liquid temperature measurement were begun. Test section drafting is in progress and the power supply with control components and wiring are yet to be completed. Void fraction profiles will be determined by X-ray beam attenuation techniques to obtain transverse and axial void profiles. Well-type manometers having 40-in. equivalent water scale with a reading accuracy of ±0.002 in. will be employed to measure static pressures. Liquid velocity profiles in bubbly flow will be analyzed mathematically. Small traversing thermocouples with adequate immersion length will measure temperature profiles. The test section for measurements with water at high pressure was started. Details of the pressure taps are being completed. NSA

N68-11370# General Electric Co., Philadelphia, Pa. Missile and Space Div.
HIGH TEMPERATURE ABLATION INTERACTION
E. Friedman and F. L. Schuyler Oct. 1967 58 p refs Presented at the Intern. Conf. on the Mech. of Composite Mater.
(R67SD65)

A self-consistent, integrated heat shield analysis is developed. A conical anisotropic structure which is immersed in a quasi-steady hypersonic environment is considered. The internal properties of the structure are permitted to vary through its thickness. A compressible, chemically reacting nonsimilar boundary layer solution is obtained and intimately coupled with the structure's heat transfer and mass loss. Using a transient heat conduction theory and postulating mechanical behavior to be characterized by an elastic-perfectly plastic solid, the structure is analyzed with respect to its overall thickness change (due to vaporization ablation), temperature distribution, thermally-induced stress and deformation fields, surface temperature, heat transfer rate, and regions of plastic flow. Author

N68-11379# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH TEMPERATURE VAPORIZATION MECHANISMS
Gabor A. Somorjai Jun. 1967 42 p refs Presented at the 3rd Intern. Symp. on High Temp. Technol., Pacific Grove, Calif., 17–20 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17628; CONF-670935-1) CFSTI: HC $3.00/MF $0.65

Experimental information about the vaporization mechanism of solids is obtained from evaporation rate measurements which are carried out far from equilibrium. In such studies one stable face of a single crystal should be used. Vacuum evaporation rates of solids which undergo structural rearrangement, dissociation, or association upon vaporization are, in general, markedly lower ($\alpha << 1$) than the maximum evaporation rate ($\alpha = 1$) predicted by the Hertz–Knudsen–Langmuir equation. The rate controlling step in the vaporization process, in most cases, is a surface reaction followed by the rapid desorption of the vaporizing species. It is expected that most refractory compounds (carbides, oxides, borides, and nitrides) can have vacuum evaporation rates which are several orders of magnitude lower than the maximum rate derived from equilibrium studies. Several mechanisms leading to congruent and non-congruent vaporization are discussed. The vaporization characteristics of the different groups of refractory solids are summarized. Author (NSA)

N68-11415# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
THERMODYNAMIC STUDY OF THE KCL-RBCL-H_2O SYSTEM AT 25°
A. P. Ratner and L. L. Makarov Oct. 1967 16 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 32, no. 8, 1958 p 1809–1816
(PA-TT-62; AD-659775)

An extensive thermodynamic study of the system KCl-RbCl-H2O was made at 25C, the composition of the coexisting phases being determined over the entire range of component concentrations. The vapor pressure of water over saturated aqueous KCl and RbCl solutions was determined by an isopiestic method. The changes in the chemical potentials of the components with changes in the composition of the system along the solubility isotherm were calculated with the aid of the third component method. The free energy of formation of mixed KCl-RbCl crystals

at 25C was calculated. Calculations were also made of a number of other thermodynamic functions. The experimental results permitted the conclusion as to the dissimilarity in behavior of the components in the formation of mixed crystals. The data of other investigators concerning the formation at t = 25C of a continuous series of mixed KCl-RbCl crystals were confirmed. For the chemical analyses use was made of the radioactive tracers Rb86 and K42. Author (TAB)

N68-11419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEMPERATURE FIELD OF A TURBINE ROTOR COOLED BY VAPOR PASSING THROUGH CIRCULAR CHANNELS IN THE BLADE SHAFTS [TEMPERATURNOYE POLE ROTORA TURBINY, OKHLAZHDAYEMOGO PRODUVKOY PARA CHEREZ KRUGLYYE KANALY KHVOSTOVIKOV LOPATOK]
D. A. Pereverzev, L. V. Povolotskiy, and N. B. Chirkin 3 May 1967 17 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 9, 1965 p 24–27
(FTD-HT-66-743; TT-67-63244; AD-660443)

The paper presents the results of investigations of the stationary and nonstationary temperature fields in a cooled rotor of a steam turbine. The derived data can be used in creating and constructing powerful promising turbogenerator sets for supercritical steam parameters. Author (TAB)

N68-11421# Naval Postgraduate School, Monterey, Calif.
HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF SEVERAL PLATE-FIN TYPE COMPACT HEAT EXCHANGER SURFACES
P. F. Pucci, S. F. Ball, Jr., and R. E. Traister 31 Aug. 1967 64 p refs
(NPS-59PC7081A; AD-660006)

Experimental results for the convective heat transfer and flow friction characteristics of plate-fin type heat transfer surfaces are presented for five surfaces. Four surfaces had a sinusoidal fin geometry. Two of these were fabricated of stainless steel, two of nickel. One of the nickel surfaces had perforated nickel fins. The fifth surface was fabricated of stainless steel and had a triangular fin geometry. The heat transfer data were obtained by the single-blow transient testing technique and by the cyclic testing technique. The two techniques compliment each other in extending the range of testing capability. Author (TAB)

N68-11454# Brown Univ., Providence, R. I. Engineering Div.
AN EXAMINATION OF THE METHOD OF REGIONAL AVERAGING FOR RADIATIVE TRANSFER BETWEEN CONCENTRIC SPHERES
Brian L. Hunt Jul. 1967 40 p refs
(Contract Nonr-562(35))
(NONR-562(35)/20; AD-659945)

Approximate equations were derived according to the method of regional averaging for the radiative transfer in an absorbing and emitting medium between two concentric spheres. 3-region, 2-region and Milne-Eddington approximations were considered. The approximate equations were solved for two types of problem (a) no heat generation with different wall temperatures and (b) uniform heat generation with equal wall temperatures. In the solutions, the absorption coefficient of the intervening medium was assumed constant. The approximate solutions were compared with exact values obtained by earlier workers. It was found that for case (a), the 3-region and 2-region approximations give good agreement but the Milne-Eddington results were poor. For case (b), it was found that the 2-region approximation was poor, the Milne-Eddington approximation was quite good for radius ratios approaching unity but otherwise poor and that the 3-region approximation was good for small radius ratios but breaks down as the planar limit was approached. Author (TAB)

N68-11458 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC TECHNOLOGICAL MINING SOCIETY. BLASTING Selected Articles
21 Mar. 1967 109 p refs Transl. into ENGLISH from Nauch.-Tekhn. Gorn. Overchestvo. Vzrvnoe Delo (USSR), v. 52, no. 9, 1963 p 25–39, 67–80, 115–140, 189–201
(Contract AF 33(657)-16409)
(FTD-HT-66-254; TT-67-62991; AD-660249)

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7. INVESTIGATION OF ACTIVATING THE COMBUSTION SHOCK WAVE OF NITROGLYCERINE CHARGES AND ITS MIXTURES A. N. Afanasenkov, I. M. Voskoboynikov, G. S. Sosnova, and A. K. Parfenov p 81–87 refs (See N68-11465 02-33)

N68-11459 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETONATION MECHANISM OF LIQUID EXPLOSIVES [MEKHANIZM DETONATSII ZHIDKIKH VZRYVCHATYKH VESHCHESTV]
A. N. Dremin *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 1–20 refs (See N68-11458 02-33)

The detonation mechanism in liquid explosives is investigated on the basis of available theoretical and experimental data in conjunction with Shchelkin's criterion for instability of the combustion zone. The disturbances occurring in the plane of detonation, which for the pressure profile considered coincides with the Chapman–Jouguet plane, do not die out but rather increase and overtake the detonation shock wave front, which generates oblique shock waves. The reaction is initiated at the points of collision of the oblique shock waves. Photographs of the detonation propagation process in nitromethane made by a high-speed camera are presented and discussed. The propagation of detonations inside confined and unconfined charges is considered, and the concept of a wave of no reaction is introduced. The depth of its penetration in a charge is considered and related to the critical-charge diameter for the detonation of liquid explosives. Author

N68-11461 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROMAGNETIC EMISSION UPON DETONATION OF INDUSTRIAL EXPLOSIVES [ELEKTROMAGNITNOYE IZLUCHENIYE PRI VZRYVE PROMYSHLENNYKH VV]
V. N. Zenin and V. N. Mits *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 38–56 refs (See N68-11458 02-33)

A study was made of the electromagnetic radiation produced by the detonation of commercial explosives; and a hypothesis is proposed. Experiments demonstrated that the emission of electromagnetic energy depends on the expansion of gaseous explosion products in the free atmosphere and on the presence of

easily ionizing additives in the explosive (e.g., alkaline metal salts, which are sometimes used as flash suppressors). Combustible additives (sawdust aluminum powder, etc.) also tend to increase electromagnetic radiation. The amount of radiation is controlled by the volume of explosion products in the free atmosphere, and therefore the intensity of radiation and the time interval between the explosion and the first manifestation of electromagnetic radiation can be used to determine the tamping effectiveness of the material and the tamping technique employed. The explosives used were ammonites PZhV-20 and No. 6ZhV. Author

N68-11462 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON TRANSITION OF THE COMBUSTION OF EXPLOSIVE MATERIALS TO EXPLOSION [O PEREKHODE GORENIYA VZRYVCHATYKH VESHCHESTV VO VZRYV]

K. K. Andreyev *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 57–71 refs (See N68-11458 02-33)

Factors determining the transition from deflagration to explosion are investigated. If the rate of increase of gas emission and pressure in a combustion process is greater than pressure losses, a thermal explosion will occur. Because heat emission is proportional to the volume of the explosive (cube), whereas heat losses by convection are proportional only to the surface of the charge (square), one of the basis parameters determining thermal explosion is the critical size of the charge. When the volume of the charge becomes critical, heat emission will exceed heat losses leading to an explosion. In powder explosives, relative density was the decisive factor in the transition from deflagration to explosion. In liquid explosives, the point of detonation was determined by the transition from normal combustion to turbulent deflagration. Increased viscosity of liquid explosives lessens their detonation sensitivity. Author

N68-11465 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF ACTIVATING THE COMBUSTION SHOCK WAVE OF NITROGLYCERINE CHARGES AND ITS MIXTURES [ISSLEDOVANIYE VOZBUZHDENIYA UDARNOY VOLNOY GORENIYA ZARYADOV NITROGLITSERINA I EGO SMESEY]

A. N. Afanasenkov, I. M. Voskoboynikov, G. S. Sosnova, and A. K. Parfenov *In its* Sci. Technol. Mining Soc. Blasting 21 Mar. 1967 p 81–87 refs (See N68-11458 02-33)

Processes other than stable detonation were observed in explosive charges. These processes were investigated to help prevent detonation failures. Detonation and combustion procedures were investigated with nitroglycerine charges and with charges of sodatol across a 2–3 mm thick plexiglas wall. It was found that a detonation rate of 7650 m/sec occurred in passive nitroglycerine charges and that the sodatol-active charge detonated at rates greater than 2500 m/sec. It was concluded that combustion velocities obtained with nitroglycerine and its mixtures with ammonium nitrate are equal, and that decomposition of nitroglycerine plays a decisive role in the combustion process. Detonation failure of safety explosive charges in holes was also studied. It was concluded that detonation failures in safety explosives are more probably between cartridges than in one continuous charge and that at charge densities of 1.5 g/cc and over, detonation transmission from cartridge to cartridge is improbable. Author

N68-11491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

WEAK LOCALLY HOMOGENEOUS TURBULENCE AND HEAT TRANSFER WITH COMBINED TWO-DIMENSIONAL SHEAR AND NORMAL STRAIN

Robert G. Deissler Washington Dec. 1967 26 p refs

(NASA-TN-D-4273) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analysis of the effects of shear and normal strain on weak turbulence and turbulent heat transfer is made using two-point correlation equations obtained from the Navier–Stokes and energy equations. The correlation equations are converted to spectral form by taking their Fourier transforms. The resulting first-order partial differential equations are then reduced to an equivalent set of ordinary differential equations. The normal strain is taken as two-dimensional, uniform, and incompressible, with a contraction occurring in the same transverse direction as the uniform shear and temperature gradients. The turbulence is assumed to be initially isotropic but becomes anisotropic in the presence of the shear and normal strain. Author

N68-11504*# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.

MASS TRANSFER COOLING ON A POROUS FLAT PLATE IN CARBON-DIOXIDE AND AIR STREAMS

A. L. Laganelli and J. P. Hartnett (Ill. Univ., Chicago) [1967] 25 p refs

(Grant NsG-356)

(NASA-CR-90404) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Heat transfer results are reported for a transpiration cooled porous flat plate placed in a stream of air and in one of CO_2. The tests were performed at a Mach number of 1.96 over a range of effective length Reynolds number from 5 million to 9.1 million when CO_2 was used as the free stream gas. A Mach number of 2.53, for an effective length Reynolds number range of 5.3 million to 8.3 million, was characteristic when the free stream gas was air. The heat-transfer data are normalized and presented as the ratio if the Stanton number to the no-blowing Stanton value (St/St_o) as a function of the dimensionless transpiration rate F/St_o. The recovery factor data are also normalized and presented as the ratio of r/r_o as a function of the transpiration rate F. The results for both the air and the CO_2 free stream flows showed a reduction in heat-transfer with increasing transpiration rate using air and CO_2 as the injectant gases. The measured recovery factor, and the normalized recovery factor also decreased with increasing transpiration rate using air and CO_2 as the injectant gases. The measured recovery factor, and the normalized recovery factor, also decreased with increasing transpiration for the reported gas combinations. It was found that Rubesin's air theory adequately predicts all the heat-transfer results including those obtained in CO_2 atmospheres within the reported Mach number range. Also, the empirical theories which predict recovery factor results for air free streams can be used for air or CO_2 injection into a CO_2 free stream gas. Author

N68-11536# Los Alamos Scientific Lab., N. Mex.

CRYOGENIC TESTS ON A "TEFLON"-TUBE HEAT EXCHANGER

R. S. Thurston, K. D. Williamson, Jr., and J. C. Bronson [1967] 10 p refs Presented at the Cryog. Eng. Conf., Palo Alto, Calif.

(Contract W-7405-ENG-36)

(LA-DC-8659; CONF-670801-8) CFSTI: HC $3.00/MF $0.65

A heat exchanger consisting of 140 Teflon tubes, with a 0.10-in. OD, a 0.01-in. wall thickness, and a 15-in. effective length, surrounded by a 1.5-in. stainless steel shell was tested at cryogenic temperatures. In order to avoid leakage at a Teflon-metal interface a special seal was developed. The metal face of the seal contains a pair of concentric ridges of semicircular cross section which deform the Teflon. This seal has held against internal pressures up to 880 psi during thermal cycling between H_2O and IH_2, and up to 1200 psi during thermal cycling between H_2O and IN_2. Author (NSA)

N68-11553 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REFRACTION OF A SHOCK WAVE ON A FLAME FRONT [K PRELOMLENIYU UDARNOY VOLNY NA FRONTE PLAMENI]

R. I. Soloukhin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 49–59 refs (See N68-11548 02-34)

To study the effect of flame deformation on shock-wave intensification, experiments with hydrogen–oxygen and acetylene–oxygen mixtures were made in a shock tube of 50×50 mm cross section. The mixture was spark-ignited at the closed end, and the collision of the incident and reflected shock wave with the laminar flame was scanned by time-resolved Schlieren photography and oscillographic pressure recordings. The overall results of the study demonstrate that flame deformation is the major factor responsible for shock-wave intensification. On the basis of the photographs obtained, a mechanism of the transition from deflagration to detonation is outlined. It is also shown that self-ignition behind the reflected shock wave takes place when $\Delta p/p_1$ is larger than 1.6. It is emphasized that the detonation wave is formed in the compressed gas between the shock front and the flame, rather than by coalescence of the shock wave with the flame as is usually assumed. Author

N68-11554 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF THE INITIAL STAGE OF POINT EXPLOSION DIFFERENT GASES [RASCHET NACHAL'NOY STADII TOCHECHNOGO VZRYVA V RAZLICHNYKH GAZAKH]

V. P. Korobeynikov and P. I. Uchshkin *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 61–73 refs (See N68-11548 02-34)

A numerical solution of a linearized point-explosion problem with back pressure is considered in the cases of plane, cylindrical, and spherical waves in gases. A method is outlined for the solution of linearized blast-wave problems. A program was designed for the BESM-2 computer which makes it possible to obtain solutions for various values of $\gamma(1<\gamma<7)$ in the cases of plane, cylindrical, and spherical waves and to obtain functions of the total energy, temperature, and entropy in linear approximation. The results contain both autosimilar and linearized functions. The linearized solution of the blast-wave theory was applied to the problem of hypersonic flow over blunt-nosed slender bodies (M = 10–21). Comparison of the results obtained by linearized solution with those obtained by numerical solution for the flow over bodies indicated the possibility of applying the solution of the problem of blast-wave theory to solve the problem of hypersonic flow over blunt-nosed slender bodies and vice versa. Author

N68-11555 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE DEFINITION OF GAS PARAMETERS AFTER THE SHOCK WAVE FRONT BY THE LAW OF FRONT MOTION [PRIBLIZHENNOYE OPREDELENIYE PARAMETROV GAZA ZA FRONTOM UDARNOY VOLNY PO ZAKONY DVIZHENIYA FRONTA]

V. V. Adushkin and I. V. Nemchinov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 (See N68-11548 02-34) p 75–88 refs

A method is outlined for approximate determination of gas parameters behind a shock-wave front according to the known law of shock-wave propagation. The method, based on calculation of basic derivatives of gasdynamic parameters at the shock-wave front in Lagrange's coordinate system, is similar to the calculation of derivatives in Euler's coordinates. It consists in the linear extrapolation of pressure along the mass of gas in motion with respect to a known exact value of the pressure derivative at the wave front. The other parameters are calculated from gasdynamic equations. The results obtained by this method are in good agreement with those of some exact calculations of gasdynamic motions. The method is applied to gas flows with variable adiabatic exponent and heat absorption or dissipation. It is concluded that this method, in combination with the method of integral correlations, makes it possible to carry out approximate calculation of gasdynamic motions. Author

N68-11560 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPRAISAL OF THE ROLE OF RADIATION IN CALCULATION OF HEAT EXCHANGE IN A TURBULENT BOUNDARY LAYER [K OTSINKE ROLI IZLUCHENIYA PRI RASCHETE TEPLOOBMENA V TURBULENTNOM POGRANICHNOM SLOYE]

S. S. Kutateladze, I. Leontev, and N. A. Rubtsov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 119–125 refs (See N68-11548 02-34)

Heat transfer by radiation and convection in a turbulent boundary layer has been analyzed. Thermal radiation from a high-temperature gas affects the temperature field in the boundary layer and consequently the conditions of heat transfer by conduction and convection. With allowance for these factors, the analysis was based on relationships previously derived by the authors for heat transfer and friction in a turbulent boundary layer. A combined Stanton number was used as a criterion for the overall convective–radiative heat transfer. The resulting equation was applied to calculate heat transfer from a high-temperature radiating gas to a flat plate. The results demonstrate that the optical density has a substantial effect on heat transfer, particularly at high N/S_0 ratios (N/S_0 characterizes the fraction of radiation in undisturbed flow; S_0 is the Stanton number for a nonradiating gas at constant physical parameters inside the boundary layer). The comparatively simple formula derived can be used for the approximate solution of radiative–convective heat-transfer problems. Author

N68-11561 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESEARCH OF THE FORM OF THE FLAME SURFACE OF ACETYLANE DISINTEGRATION DURING PROPAGATION IN HORIZONTAL PIPES [ISSLEDOVANIYE FORMY POVERKHNOSTI PLAMENI RASPADA ATSETILENA PRI RASPROSTRAVENII V GORIZONTAL'NYKH TRUBAKH]

B. A. Ivanov and S. M. Kogarko *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 127–132 refs (See N68-11548 02-34)

The shape of the front of an acetylene flame propagating in a horizontal tube 750 mm long and 50 mm in diameter at 2.5–5 atm pressure has been studied by means of ionization gauges placed 10 mm apart in vertical and horizontal planes at the closed end of the tube. The mixture was ignited at the open end of the tube with a heated nichrome wire. Ionization-gauge measurements made with oscillographs and time-resolved photographs showed that the flame front is concave at pressures lower than 4.5 atm. At 4.5 atm and above, the flame front is convex. The existence of a stable concave flame front is explained by strong convection in the vicinity of the front. It is anticipated that other slow-burning mixtures may exhibit a transition from convex to concave flame fronts, particularly when the flame is propagating vertically downward. Author

N68-11562 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REMARKS TO THE WORK OF R. M. ZAYDEL "ON THE POSSIBILITY OF STABLE BURNING" [ZAMECHANIYA K RABOTE P. M. ZAYDELYA "O VOZMOZHNOSTI USTOYCHIVOGO GORENIYA"]

S. K. Aslonov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 133–135 refs (See N68-11548 02-34)

The author considered the stability of a flat flame front, relative to small induction perturbations, by taking into account the influence of the perturbations on the chemical reaction. He concludes that the possibility of a stable flame exists in limited condition. This limitation was attributed to the inaccurate use of the limiting condition (continuity of impulse current). Author

N68-11563 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSITION OF NORMAL BURNING OF POROUS EXPLOSIVE SUBSTANCES INTO EXPLOSION UNDER THE CONDITIONS OF WEAKLY INCREASING PRESSURE [PEREKHOD NORMAL'NOGO GORENIYA PORENIYA VZRYCHATYKH VO VZRYV V USLOVIYAKH SLABO BOZRASTAYUSHCHEGO DAVLENIYA]

V. K. Bobolev, L. F. Chekirda, and C. V. Chuyko *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 137–141 refs (See N68-11548 02-34)

Experiments with pressed hexogen of 160–250-μ particle sized and 0.7 density were conducted in a manometric bomb equipped with high- and low-speed photoregisters and with piezoelectric pressure pickups for recording the pressure in the bomb and in the pores. The pressure P* can be calculated by considering the density of the melt, the density of the solid explosive, the thickness of the molten layer at 1 atm, and the particle diameter; P* was about 3 atm for the hexogen tested. A plot of detonation pressure (P) versus the pressure-increase rate obtained with hexogen specimens 40 mm high and 8 mm in diameter showed that the characteristic time constant, the time required for development of self-ignition, is about 0.7 sec. Four combustion regimes (normal, convective, explosive, and detonative) are defined by inequalities in terms of the rate of gas penetration into the pores and the flow velocity of the combustion products. Author

N68-11564 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESEARCH ON THE SMOOTHNESS OF A DETONATIONAL WAVE FRONT [ISSLEDOVANIYE GLADKOSTI FRONTA DETONATSIONNOY VOLNY]

S. N. Buravov, A. N. Dremin, O. K. Rozanov, and V. S. Trofimov *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 143–146 refs (See N68-11548 02-34)

A study of the surface structure of a detonation wave front propagating in liquid nitromethane–acetone mixtures proved that the front is not smooth and thus confirmed a previous conclusion that detonation waves in liquids do not propagate at the same rate in all points of the front. Photographs obtained during propagation of the detonation wave disclosed traces caused by reflection from the moving metal plate and the front of the shock wave propagating in the test mixture and in water. Another experiment conducted by the light scattering technique with a nonpolished metal plate and focusing of the scattered light beam showed a trace resulting from light scattering on the detonation wave front. An approximate evaluation of these and previous experiments suggests that the dimension of the detonation front nonuniformity in the direction of the wave propagation is not more than one order of magnitude smaller than the dimension in the plane of the front. Author

N68-11571 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPLOSION THEORY IN A NONUNIFORM MEDIUM AT AN ADIABAT INDEX CLOSE TO ONE [K TEORII VZRYVA V NEODNORODNOY SREDE PRI POKAZATELE ADIABATY, BLIZKOM K EDINITSE]

B. N. Rumyantsev *In its* J. of Appl. Mech. and Tech. Phys., No. 4, 1963 21 Apr. 1967 p 175–178 refs (See N68-11548 02-34)

A short analysis has been made of point detonation on the boundary of two media. At time $t=0$ a sudden burst of energy E is released in an ideal gas with a variable density and a specific heat ratio close to one. Mass and momentum conservation equations are written in spherical coordinates, nondimensionalized and integrated. Self-similar solutions are obtained for the case $\rho=\rho(\phi)$ (ρ = density, ϕ = polar angle). Calculations are made for two limiting cases: (1) density of unexcited gas is assumed to differ only slightly from a constant value, and (2) the density of one medium is assumed to be much larger than the other. Author

N68-11599* Louisana State Univ., Baton Rouge. Dept. of Chemical Engineering.

TRANSPORT PHENOMENA IN THE CHAR ZONE. 2: EQUILIBRIUM COMPOSITION OF DEGRADATION PRODUCTS OF ABLATION

E. G. del Valle, R. W. Pike, and G. C. April 1967 47 p refs Presented at the 62d Ann. Symp. on the Technol. of Ablation, Salt Lake City, 21–24 May 1967

(Grant NGR-19-001-016)

(NASA-CR-90498) CFSTI: $3.00 CSCL 20M

The equilibrium composition of a reacting gas and gas-condensed phase mixtures were evaluated by the Rand method, and these computations were implemented by a program in Fortran IV for the IBM 7040. A comparison of the computer solution with experimental and calculated results reported in the literature show excellent agreement. The computations were applied to predict the equilibrium composition of the degradation products from phenolic resin–nylon ablative heat shields and aided in predicting the maximum amount of heat absorbed in the char zone during reentry. Author

N68-11618# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

A SURVEY OF RATE COEFFICIENTS FOR IONIZATION–DEIONIZATION REACTIONS IN NOZZLE FLOWS

C. W. Baulknight Nov. 1967 27 p refs

(RM-388)

A reasonably complete set of reaction rate coefficients is recommended for estimating ionization nonequilibrium in rocket exhausts. It is believed that these reactions are the best present approximations to the true mechanisms by which ions and electrons are generated and consumed during the combustion expansion processes in a rocket engine. The reaction rate coefficients (or more commonly called rate coefficients) apply specifically to interactions among the ionized impurities (Na^+, K^+, Li^+), their corresponding neutral species, and other species that result from the combustion of the propellant system. This system is composed of a 50–50 percent mixture (by weight) of the fuels UDMH [$(CH_3)_2$ NNH_2] and hydrazine (N_2H_4), plus an oxidizer (N_2O_4), and is popularly known as Aerozine 50/N_2O_4. Author

N68-11636* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MIST-FLOW HEAT TRANSFER USING SINGLE-PHASE VARIABLE-PROPERTY APPROACH

Yih-yun Hsu, Glenn R. Cowgill, and Robert C. Hendricks Washington Dec. 1967 81 p refs

(NASA-TN-D-4149) CFSTI: $3.00 CSCL 20M

Film-boiling mist flow is treated as a single-phase flow with properties being synthesized from those of liquid and vapor phases weighted according to their respective volume fraction. Such a synthesizing approach renders it possible to apply the technique for single-phase turbulent flow to the two-pase flow. Computational results for film-boiling hydrogen at low pressure predicts the experimental data within 25 percent; the deviation between the analytical and experimental results increases gradually with increasing pressure. Further analysis showed that the deviation was due to the assumptions of a thermodynamic equilibrium and homogeneous distribution of void. A simplified design method is proposed so that the heat-transfer coefficient can be calculated from the Dittus–Boelter equation by specifying a reference temperature and a reference void fraction for computation of properties. The coefficient for determining such a reference temperature and void is primarily a function of the bulk void fraction. Author

N68-11642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HYDROGEN–OXYGEN CHEMICAL REACTION KINETICS IN ROCKET ENGINE COMBUSTION

Martin Hersch Washington Dec. 1967 20 p refs
(NASA-TN-D-4250) CFSTI: HC$3.00/MF$0.65 CSCL 07D

Hydrogen–oxygen reaction times and concentration histories of chemical species during reaction were calculated for rocket combustor conditions. Calculations were made for oxidant-fuel weight ratios of 1 and 10 and initial reactant temperatures of 1200° to 2500°K at a chamber pressure of 20 atmospheres (2.0×10^6 N/sq m). The reaction time varied from about 0.01 second at 1200°K to a few microseconds at 2500°K. Calculations were made by using a numerical integration program and an analytical solution. The reaction mechanism used included five chain branching reactions and three recombination-type reactions. Author

N68-11667 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A TWO-DIMENSIONAL PERIODIC CONTACT. CONTACT RESISTANCE WITH ACCOUNT TAKEN OF SECONDARY FLOWS IN THE GENERAL CASE

A. L. Stasenko *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 59–70 refs (See N68-11661 02-23)

This paper considers the general problem of heat transfer, diffusion, or the passage of electric current across the contact surface of two conductors through the concept of contact resistance to the flow of the respective value (heat, mass, charge). Author

N68-11668 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETONATION IN A GAS HEATED BY A SHOCK WAVE

R. I. Soloukhin *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 71–86 refs (See N68-11661 02-23)

Analysis of a number of phenomena accompanying gas detonation has indicated the need for a special study of the properties of detonation waves in a gas previously heated to 600–1800°K, and particularly of the transition from slow burning to detonation. A new photographic technique, strip-film schlieren interferometry, was used to determine simultaneously the shock-wave pattern and the condensed-gas detonation in a nonsteady expansion of the combustion products. The close agreement between the theoretical and experimental results shows that in this case the detonation is initiated as a result of an adiabatic explosion wave generated by reflected shock heating. Two external factors are cited which affect the mechanism of detonation initiation: delayed oscillations of gas (hydrogen) molecules, and the difference in the acoustic impedances on the shock front (in an approximate ratio of 2:1) in heated and cold gas. Author

N68-11685 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DETONATION OF CONDENSED EXPLOSIVES AT LOW CHARGE DENSITIES

L. N. Stesik and N. S. Shvedova *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 235–240 refs (See N68-11661 02-23)

To study the possibility of calculating the detonation velocity of explosives with very low charge densities the detonation velocities of nitrocellulose charges (13.3% N) in cellophane cases with densities of 0.13–0.67 g/cm^3 were measured by high-speed photography. The detonation velocities of charges with lower densities were then calculated with a computer, and the results were compared with the curve of detonation velocity vs charge density extrapolated from data obtained at the higher densities. The results showed that the extrapolated values were in good agreement with calculated values. In the calculations, it was assumed that the heat capacity of nitrocellulose is 605.4 kcal/kg, thermodynamic equilibrium is established in the detonation wave, and the explosion products obey the ideal gas law. Analogous calculations were made for trotyl, tetryl, hexogen, PETN, and picric acid at a single charge density of 0.01 g/cm^3. Author

N68-11686 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE STABILIZATION OF DETONATION WAVES BY MEANS OF POORLY STREAMLINED BODIES

M. P. Samozvantsev *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 241–249 refs (See N68-11661 02-23)

It has been previously assumed that in supersonic flows, combustion takes place immediately behind the shock wave, i.e., that no ignition delay occurs and the detonation wave is an infinitesimally thin surface. It was therefore concluded that the strong detonation wave in front of a bluff body should be transformed into a Chapman–Jouguet detonation wave which is stabilized by the body. However, previous experiments revealed that although in the frontal part of a 20-mm sphere a strong detonation wave is generated, it does not change into a Chapman–Jouguet wave, but breaks down into a shock wave and a laminar flame front. To explain this phenomenon combustion kinetics and flow structure were theoretically analyzed in the present study. Analysis of the calculated results shows that in case of a 20-mm sphere the flow behind the flame front is subsonic. This explains why the Chapman–Jouguet detonation wave cannot be stabilized under these conditions. In order to obtain flow at sonic velocity behind the flame front, the diameter of the sphere must be increased roughly 20 times, i.e., to 400 mm. This value is only approximate since the calculated ignition delay may differ from actual values by a factor of 2 to 3. The necessary condition for the realization of the Chapman–Jouguet detonation is the formation of sonic flow in an arbitrary point behind the flame front. Author

N68-11687 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GAS-DYNAMIC ANALYSIS OF THE NONSTEADY-STATE PROPAGATION OF FLAME

A. S. Pleshanov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 250–255 refs (See N68-11661 02-23)

Non-steady-state flame propagation was previously analyzed by Zel'dovich, Shchelkin and others on the basis of a model with a double discontinuity (shock wave–flame front). On the basis of the same concept an analysis has been made which yielded the new conclusion that the density of stagnating combustion products in a closed tube is maximum in a Chapman–Jouguet detonation. Author

N68-11688 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASURING THE TURBULENT VELOCITY OF FLAME PROPAGATION BY THE INVERSE-CONE METHOD

I. L. Kuznetsov and M. D. Malanov *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 256–262 refs. (See N68-11661 02-23)

The turbulent burning velocity of propane–air mixtures was measured by the inverse flame-cone method at flow velocities of 8–40 m/sec and mixture compositions of 3.5%–5.5% propane. The turbulence was varied by two grids. The measurement was made with a 40×40-mm burner with a centrally located hydrogen–oxygen flame serving as ignition source. The angle at which the fresh gas entered the flame cone was determined by photographing aluminum particle trajectories or the positions of a capron thread. The latter method gave more accurate results. Author

N68-11689 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE MECHANISM OF THE AMPLIFICATION OF ACOUSTIC VIBRATIONS BY THE COMBUSTION SURFACE OF SOLID FUEL

G. K. Karakozov and G. V. Rossikhin *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 263–267 refs (See N68-11661 02-23)

The conditions under which acoustic oscillations in the combustion of solid propellants are intensified by the burning surface were analyzed. A layer is considered which is bounded by the surfaces designated as (−) and (+). The distance between the surfaces is constant. The surface (−) is situated in the gas phase at a point where the reaction is completed. The heat flux through this surface is given by a small value. The change in parameters to the left of this surface is considered to be isentropic. To the right of the surface (+), the gas is ideal and has a fixed chemical composition. Author

N68-11690 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF THE SIZE OF THE HEATING SURFACE UPON THE CRITICAL HEAT FLOW IN THE CASE OF BOILING IN A LARGE VOLUME OF LIQUID

G. I. Bobrovich, I. I. Gogonin, and S. S. Kutateladze. *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 268–272 refs (See N68-11661 02-23)

This paper discusses the relationship of the critical density of the heat flow at which film boiling of alcohol and water originates to the diameter of cylindrical heater in both the vertical and horizontal positions. Author

N68-11691 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF FRICTION AND HEAT TRANSFER DURING GAS FLOW IN A TUBE

N. M. Belyanin. *In its* J. of Appl. Mech. and Tech. Phys. 19 Apr. 1967 p 273–281 refs (See N68-11661 02-23)

An experimental investigation of friction coefficient and Stanton number for subsonic turbulent gas flow of high-temperature gas in a round tube was carried out for Reynolds numbers of $2 \cdot 10^3$ to $5 \cdot 10^3$. The main emphasis of the investigation was put on the study of the effect of the enthalpic factor on the friction coefficient and the Stanton number at subsonic flows. The cylindrical tube, in which the air was heated by an electric-arc heater, consisted of 14 heat-insulated, water-cooled sections. Openings were made in each section for the measuring of static pressure. Chromel–kopel thermocouples were fixed to each section for measuring the wall temperature. The tube was 1826.3 mm long and had an average diameter of 15.85 mm. The following parameters were measured during the experiment: current, arc voltage, air flow rate, flow and temperature of water in each section, static pressure, wall temperature, total pressure, and stagnation temperature at the exit of the tube. All measurements were made under steady static conditions. The obtained results appear to show that in approximate calculations the friction coefficient and Stanton number do not depend on the enthalpic factor for $3 < h_0/h_w < 20$, where h_0 = enthalpy at the axis of the tube and h_w = enthalpy at the wall of the tube. Author

N68-11721*# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT AND MASS TRANSFER. VOLUME 1: CONVECTIVE HEAT EXCHANGE IN A HOMOGENEOUS MEDIUM [TEPLO- I MASSOPERENOS. KONVEKTIVNYI TEPLOOBMEN V ODNORODNOI SREDE]

A. V. Lykov, ed., and B. M. Smol'skii, ed. 1967 313 p refs Transl. into ENGLISH from Nauka i Tekhnika (Minsk), 1965 Published for NASA and NSF

(NASA-TT-F-431; TT-67-51387) CFSTI: $3.00 CSCL 20M

Heat transfer and friction resistance in homogeneous media, convective processes, hydrodynamics, boundary layer flow, and unsteady state conditions are covered in a series of papers dealing with experiments in fluid and gas dynamics. For individual titles see N68-11722 to N68-11753. M.W.R.

N68-11722*# Israel Program for Scientific Translations, Ltd. Jerusalem.

NEW DATA ON THE PROPERTIES OF TRANS-SONIC FLOWS

A. A. Gukhman, A. F. Gandel'sman, V. V. Usanov, and G. N. Shorin. *In its* Heat and Mass Transfer. Vol. 1 1967 p 7–10 refs (See N68-11721 02-33)

A procedure used to study heat and momentum transfer in the region of Reynolds analog disturbance is based on independent plotting of curves that show variations in the static pressure and the heat flux density over the length of a channel. Heat flux density values are obtained by sectional withdrawal of the condensate, and static pressure is obtained by an axial probe at small intervals over the channel length. Some results are presented for a one-dimensional model, for which there was insufficient data to determine flow conditions in the boundary layer. Calculations were, therefore, made of the laminar and turbulent flow at the boundary; and comparisons are plotted for heat transfer in the supersonic section of a nozzle edge calculated by the proposed method and by other means. The effect of pressure gradients on the formation of the boundary layer is also discussed. M.W.R.

N68-11723*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL STUDY OF THE HEAT TRANSFER FROM PIPE WALLS TO MONATOMIC, DIATOMIC, AND TRIATOMIC GASES AT LARGE TEMPERATURE GRADIENTS

V. L. Lel'chuk, G. I. Elfimov, and Yu. P. Fedotov. *In its* Heat and Mass Transfer. Vol. 1 1967 p 11–18 refs (See N68-11721 02-33)

Experimental studies of the heat transfer from the wall to a turbulent gas flow inside a tube have been calculated for temperatures up to 1400°K, and 16 experiments are summarized for inlet sections and, in some instances, for sections with stabilized heat transfer conditions. Variations in Prandtl number were found to be insignificant; and Reynolds number had the most pronounced effect on heat transfer in many instances. An equation is given for the calculation of the similarity criteria of the various gases on the basis of the stream temperature; and various data are included for argon, air, and carbon dioxide. M.W.R.

N68-11724*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE HEAT TRANSFER TO ORGANIC LIQUIDS

L. S. Sterman and V. V. Petukhov. *In its* Heat and Mass Transfer. Vol. 1 1967 p 19–24 refs (See N68-11721 02-33)

Heat transfer coefficients for monoisopropyldiphenyl (MIPD) were determined experimentally and compared with several other equations for establishing heat transfer to organic liquids. Circulation velocity ranged from 4 to 15 m/sec, temperature gradients were from 13 to 150°K, Reynolds numbers from 25,000 to 420,000, and Prandtl number from 5 to 36. Nusselt number and, consequently, heat transfer coefficients decreased over the pipe length as the distance from the entrance was increased and eventually reached a constant value. Heat flux increased with heat transfer rate. Coefficients obtained in this experiment were lower than those from previously reported data. M.W.R.

N68-11725*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL STUDY OF THE HEAT TRANSFER IN THE SUPERCRITICAL REGION OF CARBON DIOXIDE

E. A. Krasnoshchekov, V. S. Protopopov, Wang Feng, and I. V. Kuraeva. *In its* Heat and Mass Transfer. Vol. 1 1967 p 25–31 refs (See N68-11721 02-33)

Heat exchange was studied during turbulent flow of supercritical carbon dioxide in a steel pipe that was heated over a wide temperature range. The increase in wall temperature was found

to be more pronounced than the increase in liquid temperature; as a result, there was a sharp decrease in heat transfer coefficient. Both the heat load and the fluid input are found to affect these coefficients. Other experiments were performed with a thermocouple fitted to each of three sections of a pipe; and a general dimensionless equation was derived on the assumption that the dependence of Nusselt number on Prandtl and Reynolds numbers was constant under noncritical conditions. Changes in wall temperature over the pipe length are plotted at various heat flux density values; and there is a local decrease in heat transfer rate under certain conditions and a practically constant rate at temperatures from 40 to 70°C. M.W.R.

N68-11726*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CONVECTIVE HEAT TRANSFER IN THE SUPERCRITICAL REGION OF CARBON DIOXIDE

E. N. Dubrovina and V. P. Skripov *In its* Heat and Mass Transfer. Vol. 1 1967 p 32–40 refs (See N68-11721 02-33)

Heat transfer by natural convection was investigated for vertical and horizontal orientations of a thin platinum filament with respect to the direction of the force of gravity. The dimensionless heat transfer equation includes a term for the characteristic length of the heating surface; and the channel diameter of 40 mm was taken as the characteristic length in all cases because the differences in orientation were negligible. It was found that the nearer the temperature of the isotherm to the critical, the higher the heat transfer coefficient. Changes in the temperature and pressure have a particularly strong effect on the heat transfer coefficient in the region in which the coefficient has the maximum value in the case of vertical orientation. Nusselt numbers and other values are presented for helium and for the five states of carbon dioxide; and turbulent convection was observed in these studies. M.W.R.

N68-11727*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THEORETICAL CALCULATION OF THE HEAT TRANSFER AND FRICTION RESISTANCE FOR CARBON DIOXIDE IN THE SUPERCRITICAL REGION

V. N. Popov *In its* Heat and Mass Transfer. Vol. 1 1967 (See N68-11721 02-33) p 41–48 refs

Heat transfer calculations are based on an analytical expression for the Nusselt number derived for steady, axisymmetrical flow of a noncompressible fluid through pipes. Heat transfer and friction resistance were calculated for several values of carbon dioxide by this equation and by some equations previously used; and the results obtained are in close agreement. M.W.R.

N68-11728*# Israel Program For Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE COOLING POPERTIES OF ETHANOL AT PRESSURES UP TO 800-9.8-10^4N/M^2

I. T. Alad'ev, P. I. Povarnin, L. I. Malkina, and E. Yu. Merkel *In its* Heat and Mass Transfer. Vol. 1 1967 p 49–52 refs (See N68-11721 02-33)

Cooling properties of ethanol were studied in a pressure loop during flow through seamless stainless steel pipes. Heat transfer at a pressure of 300-9.8-10^4n/m^2 was accompanied by thermal decomposition of the ethanol which formed a coke-like deposit on the contact surface. No thermal decomposition was observed at a pressure of 800-9.8-10^4n/m^2. In some experiments at the lower pressure, pseudoboiling occurred along with an increase in heat transfer rate; although no pseudoboiling was observed at the higher pressure. In the event of well-developed turbulent flow of ethanol and in the absence of both coke formation and pseudoboiling, heat transfer to the ethanol can be calculated according to the rules governing convective heat transfer. It was found that the wall temperature at which pseudoboiling occurred decreased with increasing flow velocity, and that preliminary heating of the liquid lead to pseudoboiling at lower heat fluxes. M.W.R.

N68-11729*# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPLICATION OF THE METHOD OF HIGH-FREQUENCY HEATING TO LIQUID-METAL HEAT TRANSFER MEDIA

D. M. Kalachev, I. S. Kudryavtsev, B. L. Paskar', and I. I. Yakubovich *In its* Heat and Mass Transfer. Vol. 1 1967 p 53–55 refs (See N68-11721 02-33)

A method of heating liquid metals to temperatures of 1273°K and higher using high frequency induction heating is described. The method was tested on a laboratory-type loop, with a heavy metal alloy and a light alkali metal. The current was supplied to the heater from a high frequency converter and a capacitor bank. The amount of heat taken up by the metal, the electric power of the generator, and the heat losses in the inductor were calculated, and the efficiencies of the heater and in the light metal loop were determined to be approximately 75% and 55%–60%, respectively. N.E.N.

N68-11730*# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT EXCHANGE DURING GAS FLOW IN PIPES WITH AN ANNULAR CROSS SECTION

B. S. Petukhov and L. I. Roizen *In its* Heat and Mass Transfer. Vol. 1 1967 p 56–64 refs (See N68-11721 02-33)

The heat transfer during turbulent air flow in annular pipes was investigated. The main measurements were made with unidirectional flow. The heat transfer coefficient was measured on the heated walls, and the adiabatic temperature was determined on the thermally insulated wall. Experiments were made while heating the inner wall with the outer wall insulated, and vice versa. Some data were also obtained while heating both walls with the same heat flux density, and during air flow in the outer tube without the inner one. Expressions are developed for calculating the heat transfer and adiabatic wall temperatures. The theoretical calculations and experimental data are graphed and discussed. N.E.N.

N68-11731*# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT TRANSFER AND HYDRAULIC RESISTANCE IN ANNULAR CHANNELS WITH SMOOTH AND ROUGH HEAT TRANSFER SURFACES

P. I. Puchkov and O. S. Vinogradov *In its* Heat and Mass Transfer. Vol. 1 1967 p 65–78 refs (See N68-11721 02-33)

Experimental details are presented on the heat transfer studies of air flow through smooth annular apertures and through apertures roughened by triangular teeth, spirals, inclined protrusions, rectangular pyramids, and multiple-start thread of rectangular profile. Empirical equations were developed for the heat transfer and hydraulic resistance, and the effects of the roughness shape are discussed. N.E.N.

N68-11732*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL INVESTIGATION OF THE HEAT TRANSFER ON THE END WALL OF A BLADE CHANNEL (IN TURBINES)

L. M. Zysina-Molozhen and I. B. Uskov *In its* Heat and Mass Transfer. Vol. 1 1967 p 79–87 refs (See N68-11721 02-33)

The average heat transfer coefficients needed for the calculation of the effect of transverse pressure gradients on the heat transfer rate were determined experimentally. Details are given on the experimental apparatus and procedures, and the data are graphed. Relations are presented for the approximate calculation of heat transfer on the end walls of the blade channels. N.E.N.

N68-11733*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CALCULATION OF THE HYDRAULIC RESISTANCE OF ANNULAR CHANNELS

Yu. P. Finat'ev *In its* Heat and Mass Transfer. Vol. 1 1967 p 88–98 refs (See N68-11721 02-33)

A mathematical discussion is presented on problems of turbulent annular flow. The Navier–Stokes equations are replaced by the equilibrium equations, the velocity profiles along the channel are determined, and the position of the maximum velocity is located. An equation is developed for the hydraulic flow resistance for a smooth circular tube. N.E.N.

N68-11734*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CALCULATION OF THE CONVECTIVE HEAT TRANSFER FOR AN INCOMPRESSIBLE LIQUID IN CHANNELS WITH COMPLICATED SHAPES

B. P. Ustimenko, K. A. Zhurgembaev, and D. A. Nusupbekova *In its* Heat and Mass Transfer. Vol. 1 1967 p 99–112 refs (See N68-11721 02-33)

Results are presented of calculations for the flow resistance and heat transfer during laminar flow of viscous incompressible liquid, and for turbulent convective heat transfer. The velocity profile and resistance in a plane curved channel are calculated. Expressions are developed for the heat transfer in plane straight channels and during circular laminar flow. The turbulent convective heat transfer problem is investigated with the aid of the hydrodynamic integrator. N.E.N.

N68-11736*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE ATTRACTIVE ACTION OF A NONISOTHERMAL LUBRICATING LAYER

M. E. Podol'skii *In its* Heat and Mass Transfer. Vol. 1 1967 p 117–126 refs (See N68-11721 02-33)

An approximate solution of the hydrodynamic equation and the energy balance is presented, taking into account the viscosity changes over the length and thickness of the lubricating layer. Emphasis is placed on the case of an axial sleeve bearing, and the boundary conditions for temperature were selected on the basis of heat distribution within a shaft. The flow of a lubricant between parallel friction surfaces was studied, and equations are given describing the plane–parallel flow. It is determined that the friction surfaces are attracted to each other because of the temperature dependence of the viscosity. N.E.N.

N68-11737*# Israel Program for Scientific Translations, Ltd., Jerusalem.

HYDRODYNAMICS AND HEAT TRANSFER IN A CONVOLUTED STREAM BETWEEN TWO COAXIAL CYLINDERS

V. N. Zmeikov and B. P. Ustimenko *In its* Heat and Mass Transfer. Vol. 1 1967 p 127–139 refs (See N68-11721 02-33)

An experiment to investigate the velocity and temperature distributions and the pulse flow characteristics in an annular channel with rotating inner cylinder is described. A method for calculating the heat transfer based on hydrodynamic theory is presented, along with new equations for the velocity profiles and resistance coefficients. Details are given on the experimental apparatus and the results are graphed. The turbulent boundary layer is divided into a laminar sublayer region, a transition layer, and the turbulent region, and the velocity profile is discussed for each region. The temperature profiles are determined for the flows near the inner wall and near the outer wall. N.E.N.

N68-11738*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL STUDY OF THE FRICTION AND HEAT TRANSFER DURING GAS FLOW IN A DIFFUSER CHANNEL WITH COOLED WALLS, DURING COMBUSTION

P. N. Romanenko and A. N. Oblivin *In its* Heat and Mass Transfer. Vol. 1 1967 p 140–147 refs (See N68-11721 02-33)

The radiant and convective heat transfer and the friction in the turbulent boundary layer in flow of diathermic gases were determined. The experiment included a stagnation temperature range from 913° to 1303°K, potential flow velocity at the inlet between 136 and 200 m/sec, wall temperature between 313° and 328°K, and a Reynolds number range of $50–150\times10^3$. The radiant and convective Stanton numbers and heat fluxes were calculated. N.E.N.

N68-11739*# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT TRANSFER IN THE HYDROHYNAMIC ENTRY SECTION OF A ROUND TUBE DURING LAMINAR LIQUID FLOW

B. S. Petukhov and Cheng-yung Chang *In its* Heat and Mass Transfer. Vol. 1 1967 p 148–157 refs (See N68-11721 02-33)

An approximation method is presented for the problem of heat transfer in the entry section with constant heat flux density on the wall. The assumptions for the characteristics of the incompressible liquid flow are outlined, and equations for the energy and velocity profiles are given. Expressions for the heat transfer and the Nusselt numbers are developed, and the results are considered to be in good agreement with the experimental data. N.E.N.

N68-11740*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL STUDY OF THE HEAT TRANSFER AND HYDRAULIC RESISTANCE IN THE ENTRY SECTION OF A FLAT CHANNEL DURING LAMINAR FLOW OF A VISCOUS LIQUID

A. A. Zhukauskas and I. I. Zhyugzhda *In its* Heat and Mass Transfer. Vol. 1 1967 p 158–162 refs (See N68-11721 02-33)

Experiments are described which investigated the local heat transfer and flow resistance heat transfer in flow resistance in streams of dropping liquids using two hydrodynamic loops with air on one and in the other water or transformer oil. The heights studied were 0.004, 0.01, 0.02, and 0.05 m, and the velocity was varied between 1.5 and 10.5 m/sec for the air stream, and 0.1 and 0.4 m/sec for water and oils. The heat transfer relations determined from the experiments are presented in graphs and are briefly discussed. N.E.N.

N68-11741*# Israel Program for Scientific Translations, Ltd., Jerusalem.

TURBULENT NONISOTHERMAL FLOW OF A VISCOUS COMPRESSIBLE GAS IN THE ENTRY SECTIONS OF AXISYMMETRICAL AND FLAT WIDENING CHANNELS WITH ZERO PRESSURE GRADIENT

E. E. Solodkin and A. S. Ginevskii *In its* Heat and Mass Transfer. Vol. 1 1967 p 163–174 refs (See N68-11721 02-33)

A mathematical discussion of the inlet flow is presented for subsonic flow velocities and within a wide range of temperatures. The effect of the lateral surface curvature on the characteristics of the axisymmetrical turbulent boundary layer is considered. A method is discussed of determining the characteristics of a round expanding channel with different Mach numbers and temperatures for the flow, and the calculated data is graphed. N.E.N.

N68-11742*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EFFECT OF THE ENTRY CONDITIONS ON THE HEAT TRANSFER IN THE ENTRY SECTION OF A TUBE WITH TURBULENT AIR FLOW

P. N. Romanenko and N. V. Krylova *In its* Heat and Mass Transfer. Vol. 1 1967 p 175–183 refs (See N68-11721 02-33)

New experimental data were collected on the effect of entry conditions on the heat transfer in the entry section of a cooled tube during turbulent flow of hot air. Generalization of the data on the basis of the local modeling theory makes it possible

to suggest a method for calculating the local heat transfer coefficients in the entry section, taking into account the entry conditions. The experimental data agree with those of other investigators. Author

N68-11743*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INTENSIFICATION OF THE HEAT TRANSFER IN AN AIR-COOLED ROUND TUBE

A. V. Ivanova *In its* Heat and Mass Transfer. Vol. 1 1967 p 184–189 refs (See N68-11721 02-33)

The heat transfer rate can be easily increased by increasing the velocity of the stream in contact with the convective heating surface. In small diameter tubes, such as increase in velocity can be achieved by imparting a spiral movement to the stream. In this study, the stream was swirled by blade swirlers, which were mounted directly at the inlet to the tube. Since an increase in the heat transfer rate requires power not only for the pumping of the heat transfer medium through the tube but also for overcoming the resistance of the swirlers, the most advantageous profile and the number of blades for each given swirling angle were determined. The results of experiments using four swirlers with angles 20, 35, 65, and 75° are presented. The data show that for a given power consumption, an increase in the swirling angle improves the economic performance of the setup. The swirlers used caused a noticeable increase in the heat transfer rate. R.N.A.

N68-11744*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE HYDRODYNAMICS AND HEAT TRANSFER IN A CHANNEL WITH TURBULIZERS ON THE HEAT TRANSFER SURFACE

E. K. Karasev *In its* Heat and Mass Transfer. Vol. 1 1967 p 190–197 refs (See N68-11721 02-33)

The effect of rectangular turbilizers with different fin width-to-height ratios on the hydraulic resistance, flow pattern, and local heat transfer of heated air flowing through a tube (fitted with a calibrated Pitot–Prandtl tube at the end of the nozzle) was studied. The measured data are plotted, and are discussed. L.S.

N68-11745*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CONVECTIVE HEAT TRANSFER IN CYLINDRICAL CHAMBERS WITH RECIRCULATION

A. S. Nevskii, A. V. Arseev, L. A. Chukanova, A. I. Malysheva, and T. V. Sharova *In its* Heat and Mass Transfer. Vol. 1 1967 p 198–205 (See N68-11721 02-33)

A number of experiments were conducted with cylindrical chambers 0.30 and 0.18 m in diameter. Each chamber was surrounded with a water jacket divided into calorimeter sections and each section had a separate water supply. The heat transferred to each calorimeter was calculated on the basis of the water flow rate through the calorimeter and the increase in its temperature. Heated air was discharged into the chamber through a central nozzle and an annular external nozzle. The total amount of air supplied to the chamber, the velocity ratio of the air supplied through the central and external nozzles, and the nozzle dimensions were varied. In some experiments, air was supplied only through one nozzle, while in others, hot air was supplied through one nozzle and cold air through the other. Results showed that higher values of the heat transfer coefficient in experiments with a low nozzle-to-chamber diameter ratio are obtained as a result of the formation of stronger recirculation streams and the creation of a more turbulent air flow in the chamber. R.N.A.

N68-11746*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CERTAIN CHARACTERISTICS OF HEAT TRANSFER AND FRICTION IN THE CASE OF LONGITUDINAL FLOW AROUND (FUEL) ELEMENTS

K. Rybacek *In its* Heat and Mass Transfer. Vol. 1 1967 p 206–214 refs (See N68-11721 02-33)

Heat transfer measurements were made in tests on a setup comprised of an open-air circulation loop and a closed cooling-water loop. The working medium was air at 1–5 atm, which transferred heat to the water-cooled tubes with a nearly constant wall temperature maintained over the length of the element. The measurements were in agreement with other published data, and with calculations. It was found that the heat transfer in a bundle of tubes with longitudinal fins is slightly lower than in the case of flow in channels; while the measured resistances are 10% to 30% higher than the respective values for a smooth channel. L.S.

N68-11747*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION ON THE HEAT TRANSFER AND RESISTANCE OF FINNED, STAGGERED BANKS WITH FINS OF DIFFERENT SHAPES

V. F. Yudin and L. S. Tokhtarova *In its* Heat and Mass Transfer, Vol. 1 1967 p 215–223 refs (See N68-11721 02-33)

Comparative studies on the heat transfer and resistance of finned, staggered banks were carried out on tubes of cylindrical studs, flat fins, disk fins, wire fins, and disk fins with zigzag surface roughness imparted by tooth-shaped protuberances. Geometric characteristics of the finned surfaces, and physical characteristics of the staggered banks, are tabulated. The experimental results were processed in terms of dimensionless similarity numbers for a mathematical function, and the plotted data for the various surfaces and banks studies are depicted. Optimum performance was obtained with a bank fitted with copper wire fins. Results indicate that fin shape has no substantial effect on the heat transfer process. It is recommended that the selection of the type of surface for a heat exchanger should be based on the facilities for production of finned tubes and the reliability of the heat exchanger. L.S.

N68-11748*# Israel Program for Scientific Translations, Ltd., Jerusalem.

GENERALIZATION OF THE LAWS GOVERNING HEAT TRANSFER AND PRESSURE DROP DURING TRANSVERSE FLOW OF GASES IN FINNED TUBE BANKS

I. Vampola *In its* Heat and Mass Transfer. Vol. 1 1967 p 224–231 refs (See N68-11721 02-33)

A series of heat transfer and pressure drop measurements were made on gases transversely flowing in contact with banks of finned tubes. Three types of finned tubes, and thirty different finned-tube distribution patterns were used in the studies. Most measurements were carried out with air pressure close to atmospheric, but in some cases tubes designated for synchronous hydrogen turbogenerators were tested in media with various hydrogen contents. Air in the tubes was heated or cooled by water jackets. Experimental results were processed in the form of dimensionless functions, and were useful in deriving some fairly accurate general laws governing heat transfer and pressure drop for the stated conditions. L.S.

N68-11749*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EFFICIENCY OF HEAT TRANSFER SURFACES

A. I. Mitskevich *In its* Heat and Mass Transfer. Vol. 1 1967 p 232–238 refs (See N68-11721 02-33)

A mathematical method for evaluating the efficiency in convective heat transfer, which can be applied to different surfaces is proposed. In the method, a standard heat transfer surface to which all other surfaces are compared and the heat transfer surface under consideration, both occupying the same construction volumes, are studied at equal power consumptions (for the pumping of the heat transfer medium). The ratio of the amounts of heat transferred at equal temperature gradients (between the heat transfer surface and the medium) is then determined. The ratio is

designated the efficiency coefficient. Derivations of functions involved in the method, and curves obtained from the method for the heat transfer efficiency of helium, carbon dioxide, and hydrogen gases are given. L.S.

N68-11750*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE UNSTEADY LAMINAR THERMAL BOUNDARY LAYER ON A SEMI-INFINITE PLATE IN A VISCOUS LIQUID FLOW
Yu. L. Rozenshtok *In its* Heat and Mass Transfer. Vol. 1 1967 p 239–248 refs (See N68-11721 02-33)

Viscous dissipation and viscosity changes in the thermal characteristics of the investigated fluid (as a function of temperature) are neglected in obtaining a set of Prandtl equations for a plane unsteady laminar boundary layer for homogeneous flow of the fluid. Velocity and temperature fields in the boundary layer are examined for various cases of Prandtl number substitution in the equations. L.S.

N68-11751*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DETERMINATION OF THE STREAM TEMPERATURE AND FRICTION COEFFICIENT IN CHANNELS DURING STEADY NONISOTHERMAL FLOW OF A HEAT-TRANSFER MEDIUM
E. K. Kalinin *In its* Heat and Mass Transfer. Vol. 1 1967 p 249–257 refs (See N68-11721 02-33)

An energy equation referred to unit volume for one-dimensional unsteady flow in a channel with heat supply is applied to a channel volume element, and a mass flow rate factor is introduced to obtain a new relation giving the specific heat flux per unit surface for the heated channel. By substituting various variables, the equation is transformed into a form allowing calculation of the average velocity over the channel length. The Cauchy problem for certain regions along the channel is solved theoretically, and an example problem is presented. L.S.

N68-11752*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ACCOUNTING FOR THE EFFECT OF THERMAL UNSTEADY STATE ON THE COEFFICIENT OF CONVECTIVE HEAT TRANSFER DURING FLOW ROUND SPHERICAL BODIES AT SMALL REYNOLDS NUMBERS
L. I. Kudryashev and A. A. Smirnov *In its* Heat and Mass Transfer. Vol. 1 1967 p 258–265 refs (See N68-11721 02-33)

A general method for solving the prescribed heat transfer problem is presented, and is used to derive equations for determining the coefficient of convective heat transfer taking into account the effect of the thermal unsteady state. The solutions of Nussel and Kudryashev (for heat transfer through and on a sphere at small Reynolds numbers) are shown to be particular cases of these general equations. L.S.

N68-11756* General Dynamics/Convair, San Diego, Calif.
STUDY OF EXHAUST PLUME RADIATION PREDICTIONS Final Report
Dec. 1966 143 p refs
(Contract NAS8-11363)
(NASA-CR-90499; GDC-DBE66-017) CFSTI: $3.00 CSCL 20M

A uniform volume of high temperature water vapor was produced above the combustion zone of a flat burner. Emission and absorption measurements were made with pathlengths of 2, 5, and 10 ft. From these measurements mean absorption coefficients and fine structure parameters were deduced in the spectral interval from 1000 to 9000 cm^{-1}. These data are given in graphical and tabular form along with polynomial representations. The results were combined with previous data to generate tables of water vapor absorption coefficients covering the spectral region 50 to 9300 cm^{-1} and the temperature interval 300° to 3000°K. The fine structure parameter representation covers the intervals 1150 to 9300 cm^{-1} and 1250° to 2750°K. In addition, the high pressure limit calculation for the total emissivity to self-broadened and nitrogen broadened water vapor was extended, band models for randomly distributed Doppler lines were studied, an error and sensitivity analysis was made of the inhomogeneous radiance calculational method, and an alternative expression for the collision broadened line width was studied. R.N.A.

N68-11759 General Dynamics/Convair, San Diego, Calif.
THERMAL ANALYSIS OF SPACECRAFT ACTIVE HEAT REJECTION SYSTEMS
E. J. Russ, W. Tsunoda, and L. Trammell Dec. 1966 83 p refs
(GDC-ERR-AN-1074)

This spacecraft environmental control study is a mathematical thermal analysis to describe the typical heat loads and component temperatures in a spacecraft employing active heat rejection systems. The initial objective in the analysis accounts for all the heat load sources and their modes of heat transfer. This includes the mathematical equations of the typical spacecraft components, such as heat exchangers, cold plate electrical loads, electrical motors, etc. The heat load mathematical equations which describe an active heat rejection system were developed into a computer program. The program determines fluid temperatures, component surface temperatures, and various component heat fluxes. The program affords a generalized approach and has the flexibility to accommodate different active heat rejection systems in the preliminary design stages. Author

N68-11767# National Bureau of Standards, Boulder, Colo. Cryogentics Div.
THE SINGLE-ENGINE CLAUDE CYCLE AS A 4.2°K REFRIGERATOR
R. C. Muhlenhaupt and T. R. Strobridge 1 Jun. 1967 79 p refs
(NBS-TN-354) GPO: $0.45

The performance of the 4.2°K Claude-cycle refrigerator has been computed taking into account the efficiencies of the various components. The results are presented in graphical form. These charts give the input power requirements, mass flow rates for both the compressor and expander, pertinent temperatures, and allow selection of the optimum high pressure for a given set of component characteristics. Author

N68-11770 Sheffield Univ. (England). Dept. of Fuel Technology and Chemical Engineering.
EXPERIMENTAL TECHNIQUES FOR SUPERSONIC COMBUSTION RESEARCH IN A SHOCK TUNNEL
J. Swithenbank and R. J. Parsons 1967 64 p refs 30th Propulsion and Energetics Panel Meeting on New Exptl. Tech. in Propulsion and Energetics Probl., Munich, Sep. 1967
(HIC-95)

Scramjet combustion chamber simulations require air at extremely high enthalpy and pressure. This study is concerned with the combustion chamber conditions rather than the ambient conditions, and with the use of a tailored interface shock tunnel for producting an air stream corresponding to that at the exit of an intake. The supersonic combustion test chamber may be directly connected to the shock tunnel nozzle. Start of the flow in the test section is accompanied by a transient shock whose strength may be reduced by pre-evacuation. Fuel (usually hydrogen) is injected into the test section, and the mixing, reaction, and aerodynamic processes were investigated. In addition to conventional pressure and shock speed instrumentation, electromagnetic induction techniques were used to measure gas velocity. The electrical conductivity of the gas limits the range of applicability, and radio frequency probes were used to indicate its magnitude. High speed gas sampling valves may be used to measure the fuel concentration in the mixing region; however, care must be taken with probe design. High speed cine photography was successfully used for flow visualization. K.W.

N68-11782* Aerochem Research Labs., Inc., Princeton, N. J.
RATE CONSTANTS FOR CALCULATIONS ON NOZZLE AND ROCKET EXHAUST FLOW FIELDS
D. E. Jensen and S. C. Kurzius Mar. 1967 31 p refs
(Contract NAS8-20293)
(NASA-CR-90528; TP-149) CFSTI: $3.00 CSCL 07D

A list of rate constants of reactions important in nozzle and rocket exhaust flow fields is given. Rate constants (expressed as functions of temperature) are either taken directly from the best experiments described in the literature or estimated by comparison with known rate constants for similar reactions and with theory. Estimates of probable errors in rate constants are included, and give the engineer likely to use the rate constants a feeling for the uncertainties in these numbers. Author

N68-11784*# Aerojet-General Corp., Sacramento, Calif. Propellant Research and Development Div.
A STOP–START STUDY OF SOLID PROPELLANTS Final Report
P. L. Michell [1967] 150 p refs
(Contract NAS1-6600)
(NASA-CR-66487; Rept.-1090-81F) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The role of thermal properties and chemical kinetics of the solid phase in the combustion process of propellants was determined both analytically and experimentally. New techniques were developed to measure these properties under conditions of steady state and transient deflagration. Contributions of solid phase reactions and radiation, which in the past have been considered to be negligible, have been shown to be of particular importance in determining the extinguishability of solid propellants as well as the steady state burning process. Author

N68-11811*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF CONVECTIVE STAGNATION HEAT TRANSFER IN AIR, CO_2–N_2, AND CO_2–Ar_2 GAS MIXTURES
Clifford M. Akin and Joseph G. Marvin Washington Nov. 1967 15 p refs
(NASA-TN-D-4255) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Convective stagnation-point heat transfer was measured on hemispherical models in air, in 50% CO_2, 50% N_2, and in 65% CO_2, 35% Ar (by volume). The measurements were made in combustion-driven shock tubes over a total enthalpy range from 9.3×10^6 to 48×10^6 J/kg with corresponding stagnation-point pressures from 15 to 160 atmospheres. At the same stagnation enthalpy and pressure, no significant difference was found between the heat transfer measured in air and in the gas mixtures. This observation agrees with theory. The data were adequately predicted by theories which took into account the stagnation-point stagnation–point pressures of the present tests. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-11077# Tactical Air Command, Langley AFB, Va. Office of Operations Analysis.
A SIMULATION OF SQUADRON OPERATIONS
Howard J. Talley, Jr. Oct. 1967 39 p
(TAC-OA-WP-139; AD-660082)

The paper documents and describes a simple, Monte Carlo model which simulates (grossly) the flying and maintenance activities of a squadron of aircraft. Author (TAB)

N68-11138*# Illinois Univ., Urbana. Coordinated Science Lab.
COORDINATED SCIENCE LABORATORY PROGRESS REPORT FOR MARCH–AUGUST, 1967
2 Oct. 1967 237 p refs
(Grants NsG-443; NsG-376; NsG-228-62; NSF GK-36; Contract DAAB07-67-C-0199)
(NASA-CR-90378; AD-660324) CSCL 20L

Contents: Surface physics; Applied physics; Plasma physics; Rarefied gas dynamics; High-voltage breakdown; Space sciences; Semiconductor physics; Computer; Plasma display; Infrared converter; Information science; Networks; Control systems; Switching systems. TAB

N68-11307*# National Aeronautics and Space Administration, Washington, D. C.
NASA THESAURUS: SUBJECT TERMS FOR INDEXING SCIENTIFIC AND TECHNICAL INFORMATION. VOLUME 1: ALPHABETICAL LISTING A–L
Dec. 1967 441 p
(NASA-SP-7030) CFSTI: HC $3.00/MF $0.65 CSCL 05B

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N68-11308*# National Aeronautics and Space Administration, Washington, D. C.
NASA THESAURUS: SUBJECT TERMS FOR INDEXING SCIENTIFIC AND TECHNICAL INFORMATION. VOLUME 2: ALPHABETICAL LISTING M–Z
Dec. 1967 428 p For abstract see N68-11307
(NASA-SP-7030) CFSTI: HC $3.00/MF $0.65 CSCL 05B

N68-11309*# National Aeronautics and Space Administration, Washington, D. C.
NASA THESAURUS: SUBJECT TERMS FOR INDEXING SCIENTIFIC AND TECHNICAL INFORMATION. VOLUME 3: APPENDIXES
Dec. 1967 651 p For abstract see N68-11307
(NASA-SP-7030) CFSTI: HC $3.00/MF $0.65 CSCL 05B

N68-11321 Joint Publications Research Service, Washington, D. C.
SPECIAL USES OF ELECTRON MICROSCOPE AND CESIUM THERMAL EMISSION CONVERTER
14 Nov. 1967 18 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 23, no. 3, Sep. 1967 p 208–213, 226–229
(JPRS-43323; TT-67-33947) CFSTI: $3.00

CONTENTS:

1. STUDY OF THE OPERATION OF A CESIUM THERMAL EMISSION CONVERTER WITH MOLYBDENUM CATHODE F. V. Kondratyev, G. V. Sinyutin, and V. F. Tikhonov p 1–9 refs (See N68-11322 02-03)

2. ELECTRON MICROSCOPE STUDY OF RADIATION DAMAGE IN BERYLLIUM OXIDE A. V. Khudyakov, Z. Ya. Ostrovskiy, and V. I. Klimenkov p 10–15 refs (See N68-11323 02-18)

N68-11449# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NUMBER 10 Monthly Review of Selected Foreign Scientific and Technical Literature

Oct. 1967 48 p refs

Accomplishments are briefly reported in research on an irradiated and heat treated poly(vinyl acetate) semiconducting polymer, and in studies concerned with the monitoring of solar X-rays to aid in the establishment of a reliable flare warning system. Notes are included of studies on (1) the experimental operation of a gas maser aboard an artificial earth satellite, (2) automatic diagnosis of human organisms, (3) Echo-2 ultrasonic encephalograph, (4) the NMR method to study the incorporation of plasticizers into polymers, (5) laser simulation of nuclear explosions, and (6) a multichannel receiver for space signals. For more specific information see N68-11450 and N68-11451. C.T.C.

N68-11548 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS, NO. 4, JULY–AUGUST, 1963 (COLLECTION OF ARTICLES)

21 Apr. 1967 265 p refs Translated into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, Jul.–Aug. 1963 p 1–136
(FTD-MT-64-88; TT-67-63048; AD-659684)

Contents: Hydrodynamics of Liquids with free boundaries; Motion in liquid of a body bounded by a multiply connected surface; Coefficient of efficiency of a ground explosion; Explosive waves in loess-like ground; Refraction of a shock wave on a flame front; Calculation of the initial stage of point explosion different gases; Definition of gas parameters after the shock wave front; The collision of two plates; Scattering of a point mass of gas; Border conditions on the contact surface of an ionized gas and a solid body; Radial distribution of radiation parameters in an axially symmetric gaseous substance; Role of radiation in calculation of heat exchange in a turbulent boundary layer; Form of the flame surface of acetylene disintegration; Remarks on Zaydels On the possibility of stable burning; Transition of normal burning of porous explosive substances into explosion; Smoothness of a detonational wave front; Displacement of chemical equilibrium at disturbance of a maxwellian distribution; Positive pole of an electric arc in a current; Threshold conditions for the distribution function of charged particles; Influence of coulomb interaction of electrons with ions on the optimum composition of a gas mixture; Motions of cold plasma; Supersonic currents in the presence of irreversible processes; Explosion theory in a nonuniform medium; Theory of probability processes in water power; Anisotropic creep of disks; Creep of glass plastic plates. TAB

N68-11601 Joint Publications Research Service, Washington, D. C.

REPORTS OF THE TECHNICAL SCIENCE DEPARTMENT OF THE HUNGARIAN ACADEMY OF SCIENCES

30 Nov. 1967 98 p refs Transl. into ENGLISH from Mta Muszaki Tudomanyok Osztalyanak Kozlemenyei (Budapest), no. 38, 1967
(JPRS-43529) CFSTI: $3.00

CONTENTS:

1. RESULTS AND DEVELOPMENT TRENDS IN AUTOMATION, TECHNICAL CYBERNETICS RESEARCH O. Benedikt p 1–21 (See N68-11602 02-10)

2. HUNGARIAN BASIC RESEARCH ON SEMICONDUCTORS G. Szigeti p 22–50 (See N68-11603 02-26)

3. HUNGARIAN TUNGSTEN RESEARCH T. Millner p 51–61 (See N68-11604 02-17)

4. ACHIEVEMENTS AND TASKS OF TECHNICAL MECHANICS IN METALLURGY AND MECHANICAL ENGINEERING L. Gillemot p 62–78 (See N68-11605 02-15)

5. ACHIEVEMENTS AND TASKS OF TECHNICAL MECHANICS IN THE ENGINEERING AND CONSTRUCTION SCIENCES K. Szechy p 79–90 (See N68-11606 02-32)

N68-11719*# Technical Operations, Inc., Arlington, Va. Washington Research Center.

A PROTOTYPE SELECTION SYSTEM FOR THE OPTIMAL CHOICE OF AN INSTRUMENT PACKAGE

Robert M. Barnes, Joseph Diestal, and Stanley B. Rosen Sep. 1967 41 p refs
(Contract NAS12-515)
(NASA-CR-86008) CFSTI: HC $3.00/MF $0.65 CSCL 14A

A prototype selection aid for use in selecting instrument packages to be flown abroad space vehicles is described. The prototype selection system utilizes a set of computer programs, sequences, and formulates a quantifying system for selection. At some time well before the flight date, selection committees are presented with a greater number of candidate instruments than the vehicle can handle, because of weight, power, cost, or crew time constraints. In a full scale selection system, the committee members vote for each instrument by attaching benefit values to each instrument for each of a number of categories, such as scientific worth, technological feasibility, etc. Each instrument will end up with a total benefit value, which is the weighted votes of the committee members, with the use of a computer program. Given each instrument's benefit value and resource (such as weight, power, etc.) requirements and the total constraint for each resource, a program (based upon dynamic programming) chooses the combination of instruments which will be of maximum value. An additional program gives the committee members the option of trying alternate assignments for trade-off analysis. Author

N68-11798 Kienbaum Unternehmensberatung, Gummersbach (West Germany).

STUDY ON THE INFLUENCE OF NUCLEAR DEVELOPMENTS ON CONVENTIONAL INDUSTRY [STUDIE UBER DIE EINFLUSSE VON ENTWICKLUNGEN IN DER KERNTECHNIK AUF DIE HERKOMMLICHE INDUSTRIE]

Brussels EURATOM Sep. 1967 680 p refs
(Contract EURATOM-033-61-1 ECID)
(EUR-3616.D) CFSTI: $3.00

Many branches of industry have been, and are still being, indirectly influenced by developments which had their origin in nuclear technology. This so-called "spin-off" has led to a number of important, and in some cases surprising, advances in the most widely differing fields. This report sets out the results of a study which can be regarded as a first step towards the systematic investigation of both the technical and the consequent economic and social effects of nuclear technology on conventional industries. The study was based on a representative enquiry conducted among research centres and industrial enterprises (i.e., a collection of "cases"). For this purpose a "case" was defined as: the consequence of a development stemming from or influenced by nuclear technology to the sectors designated "knowledge", "processes", "materials" and "equipment". Altogether, some 350 "cases" were covered. These were classified according to a numbering system which, together with a code for the fields of application, forms the basis for a numerical listing and evaluation of the data. The study aimed primarily at identifying and extracting the characteristics of a limited number of particularly striking "cases". Despite the introductory nature of this initial study, several generally valid assertions can be made concerning the principal mechanisms governing the transfer of nuclear developments to conventional fields and as regards the factors of influence that play a part therein. It emerges clearly from this investigation that the intensification and perfection of the transfer mechanisms would give a new impetus to the economy. Author

N68-11810*# Systems Technology and Applied Research Corp., Dallas, Tex.

FACTORS AND PROCEDURES INFLUENCING THE RELIABILITY OF AGRICULTURAL DATA FROM EARTH ORBITING SENSOR SYSTEMS Final Report

Bill Mullins 27 Jun. 1967 234 p refs
(NASA Order R-09-038-001)
(NASA-CR-90211) CFSTI: $3.00 CSCL 02B

Accomplishments are reported in a study of potential economic benefits and data systems from agricultural resource surveys by earth orbiting sensor systems. Factors influencing the acquisition of statistically reliable satellite obtained data (imagery) for worldwide agricultural development and prediction are discussed. The following areas are considered in detail (1) the nature of the needs and services of the United States Department of Agriculture as a potential user of high altitude imagery in the preparation of agricultural statistics. (2) targets of interest in agriculture and forestry with a potential for high altitude discrimination including emphasis on special and temporal dispersion of select targets. (3) the nature of and requirements for areal sampling. (4) general satellite remote sensing systems capabilities and requirements, and (5) orbital requirements. C.T.C.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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